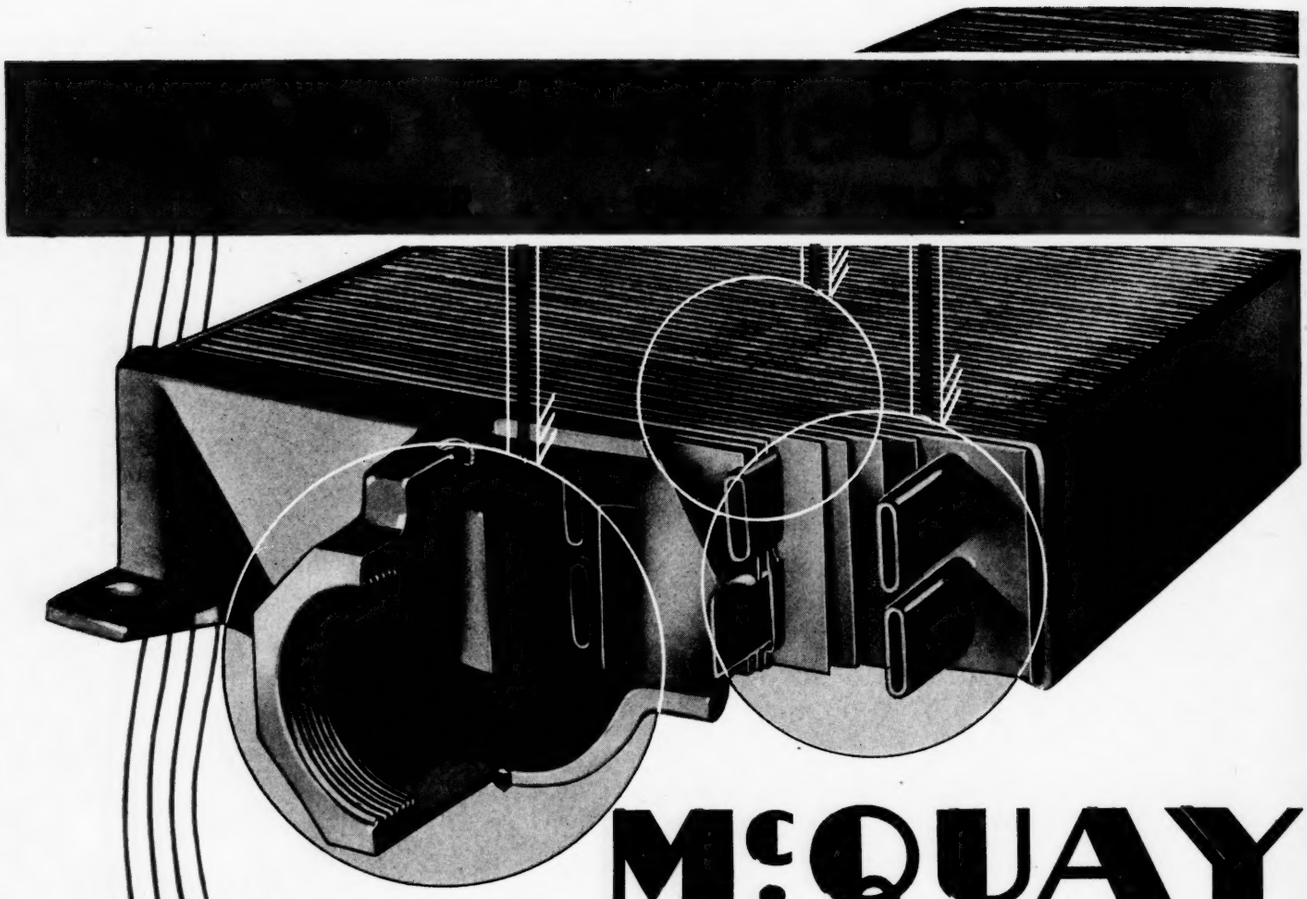


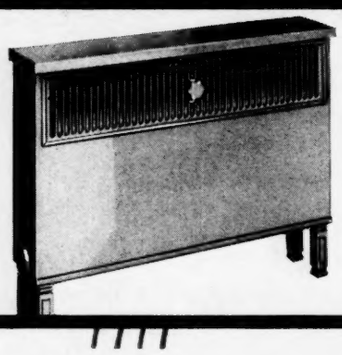
McQUAY

All-Copper Heating Element for Modern RADIATORS

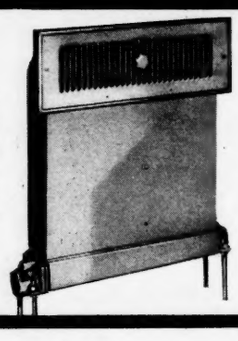
A complete set of McQuay Catalogs in a suitable binder is available for your files and will be sent at your request - - - -

All Copper Radiation has been found to be the most efficient in providing instantaneous controlled heat for the modern office building, apartment house or home.

Architects, contractors, and builders everywhere have found satisfaction in specifying and installing McQuay seamless heating elements because of their durability, quick response to the heat supplied, and freedom from up-keep costs.



McQuay Cabinet Type Radiators are housed in artistic cabinets of rustless copper alloy steel and contain the "all-one-unit", seamless, all-copper heating element.



McQuay Concealed Type Radiators fit snugly within the walls, under bookcases or windows, and are built in the correct size to fit the interior construction.

McQuay Unit Heaters are used in all types of buildings for quick, continuously circulating heat.

KEWANEE STEEL BOILERS

Steel, riveted construction; strong enough to stand the ravages of time, and the stress and strain imposed on every boiler; *adds extra years to the life* of Kewanee Boilers.

Those extra years—plus the fuel saving guaranteed for every year by correct, unskimped design—make a Kewanee by far the best boiler investment an owner can have.

The arrival of Type "R" Steel Residence Boiler means that every building, without exception, can now have the advantages of Kewanee's superior design and construction.

Turn back the pages a few years and we find fences of wood rails. Then came steel fencing and farmers soon learned that even though it cost a bit more initially the extra years of life made it a better investment.

KEWANEE BOILER CORPORATION
division of American Radiator & Standard Sanitary Corporation
KEWANEE, ILLINOIS *Branches in Principal Cities*
MEMBER OF STEEL HEATING BOILER INSTITUTE

It Costs Less to OWN a KEWANEE

HEATING AND VENTILATING, *formerly* THE HEATING AND VENTILATING MAGAZINE, published by BUILDING DIVISION OF NATIONAL TRADE JOURNALS, INC., 521 Fifth Ave., New York, N. Y. Subscription rates: United States, $2.00; Canada, $2.50; Foreign, $3.00. Single Copies, 30 cents. Vol. XXVII, No. 12, December, 1930. Entered as second-class matter, April 18, 1925, at the Post Office at New York, N. Y., under the Act of March 3, 1879. Copyright, 1930, by NATIONAL TRADE JOURNALS, INC.

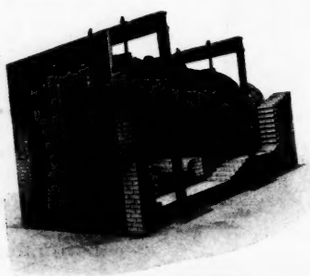
Cincinnati OK's Stanwood Electric Welded Boilers

STEEL HEATING

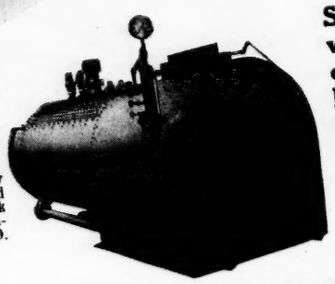
One after another, architects and engineers specify Stanwood Welded Boilers in the Cincinnati territory. For schools, hotels, small or large apartment buildings, warehouses, factories—in fact for every use conceivable, they wanted Stanwood. This boiler has won many friends on performance—supplying heat to meet the most rigid requirements. Not only in Cincinnati, but in other parts of the country, Stanwood Boilers have gained a reputation for economical, dependable service—life without costly maintenance—performance more than we claim for it. Get the true picture of Stanwood Welded Boilers today by writing for Bulletin No. 100.

Built for Coal, Oil, or Gas

Smokeless or Direct Draft Type, or for Mechanical Firing with Stokers every coal as.



ABOVE—Stanwood Horizontal Tubular Boiler in a brick setting. Write for Bulletin No. 262 showing this boiler in the Catenary Steel Casing.



RIGHT—Stanwood Smokeless, Self-Contained Boiler—having the lowest water line of any steel boiler made. Rapid water circulation insures quick steam and high overall efficiency. Ask for Bulletin No. 600.

Boilers for Every Need

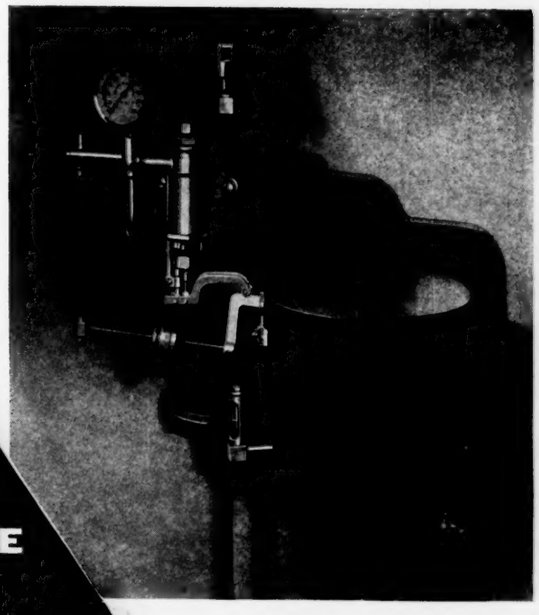
Stanwood also builds Horizontal Tubular Boilers with steel casings or for brick settings, and self contained riveted boilers possessing an extremely low water line which allows installation where headroom is limited or excavation undesirable. Many interesting facts await those who request additional information.

Write Department D-1230

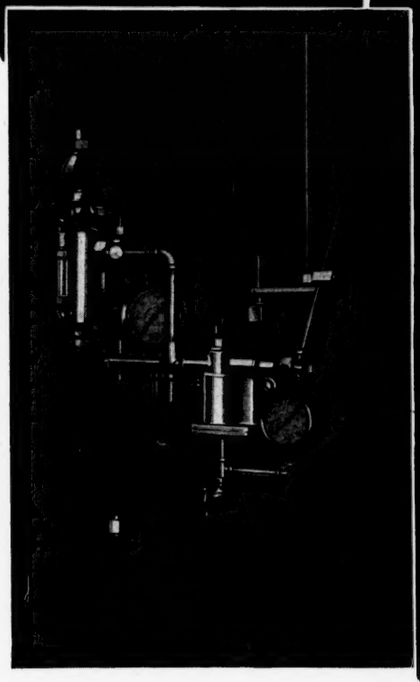
THE STANWOOD CORPORATION

Established 1891 *Cincinnati, Ohio*

A-JACKS AUTOMATIC CONTROL for HIGH PRESSURE BOILERS



A-Jacks for Control of Furnace Pressure



A-Jacks for Control of Steam Pressure

STOKER FEED
BLOWER SPEED
STEAM PRESSURE
FURNACE PRESSURE

A-JACKS Control for High Pressure Boilers is a combination of equipment that accurately controls stokers, blowers and dampers to maintain even boiler pressure.

A bulletin, just published, gives details of design, operation and installation. A copy will be mailed to you on request.

NATIONAL REGULATOR CO.
2309 Knox Avenue - - - Chicago

NATIONAL REGULATOR CO.,
2309 Knox Ave., Chicago.

Send us copy of new bulletin—"A-JACKS Control for High Pressure Boilers."

Name.....

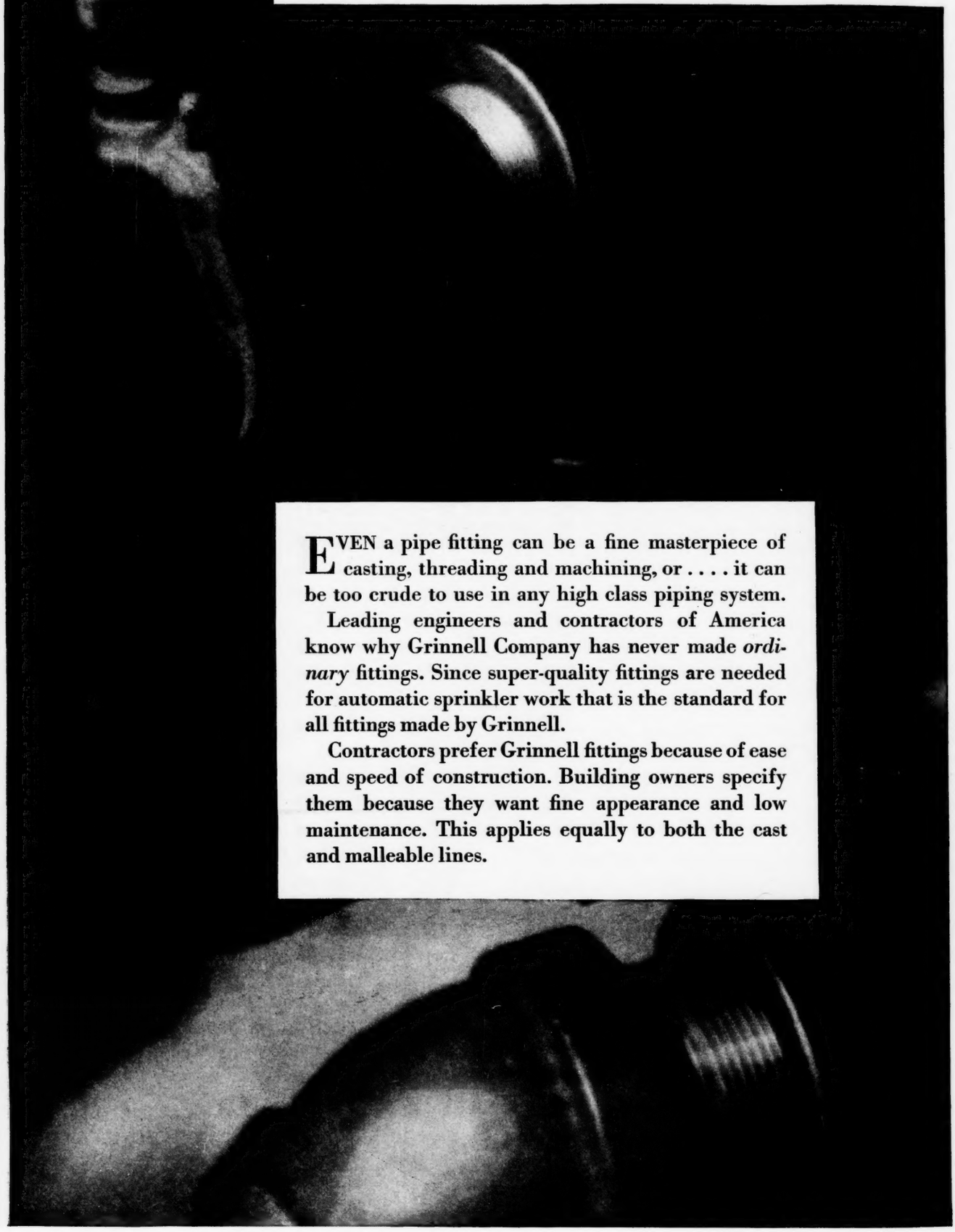
Address.....

Town..... **State**.....

Attention of.....

8532

PIPE FITTINGS

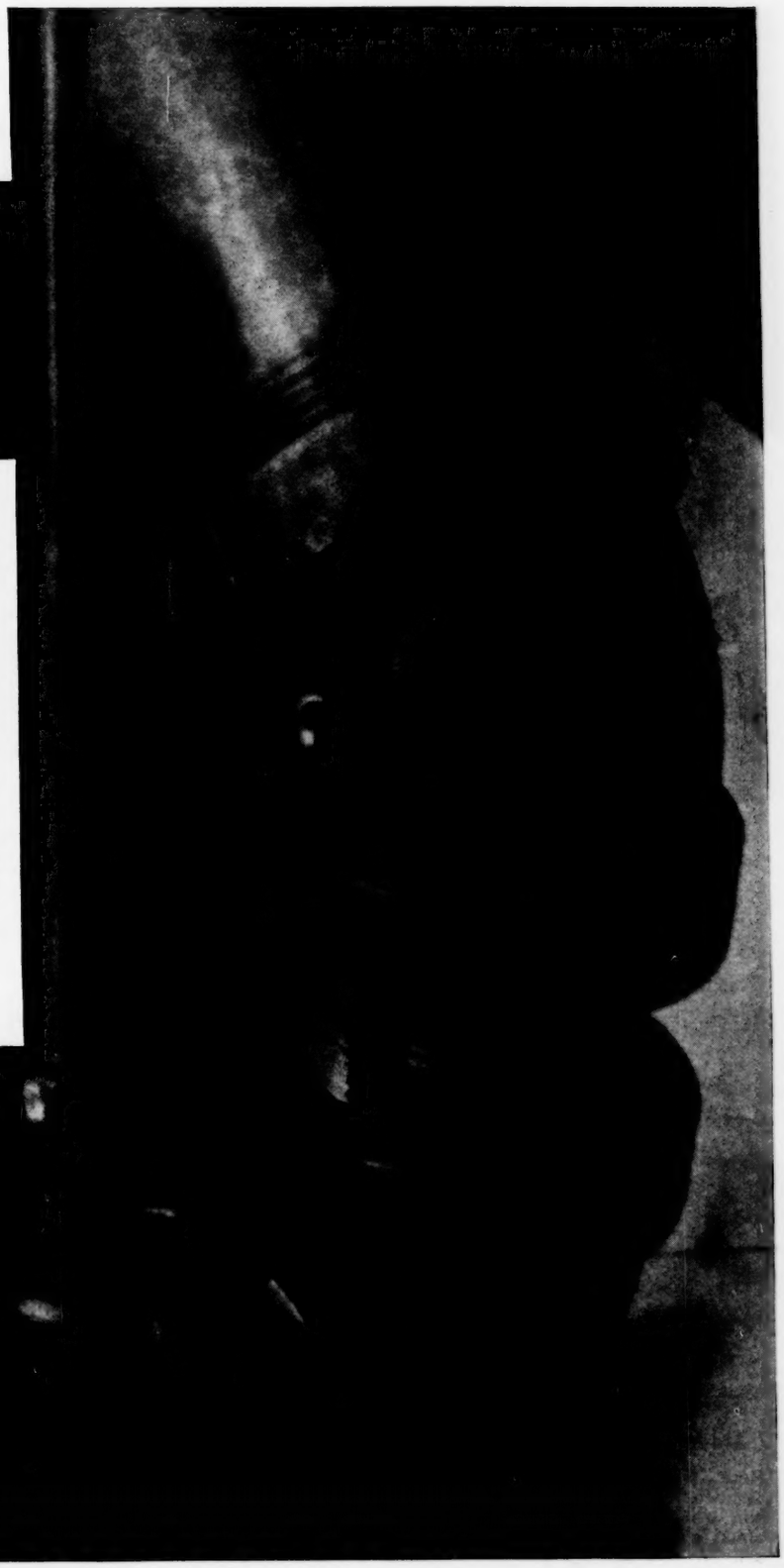


EVEN a pipe fitting can be a fine masterpiece of casting, threading and machining, or . . . . it can be too crude to use in any high class piping system.

Leading engineers and contractors of America know why Grinnell Company has never made *ordinary* fittings. Since super-quality fittings are needed for automatic sprinkler work that is the standard for all fittings made by Grinnell.

Contractors prefer Grinnell fittings because of ease and speed of construction. Building owners specify them because they want fine appearance and low maintenance. This applies equally to both the cast and malleable lines.

by
GRINNELL



BIG piping contractors have also learned to cut costs with Grinnell brackets and adjustable hangers.

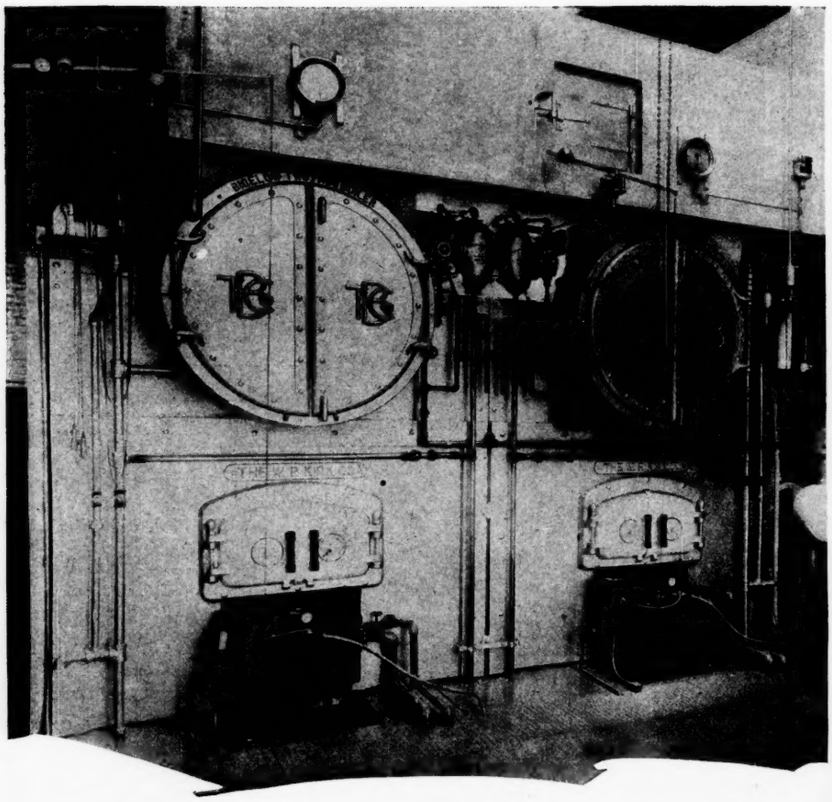
Speedy installation is what makes profits these days. The quicker the pipe is hung the sweeter the profits!

By turning an adjusting nut on a Grinnell hanger, your workman levels his line to a hair's breadth as fast as it is hung. When finished, your installation is the pride of the owner. The architect wants your bids on his next jobs.

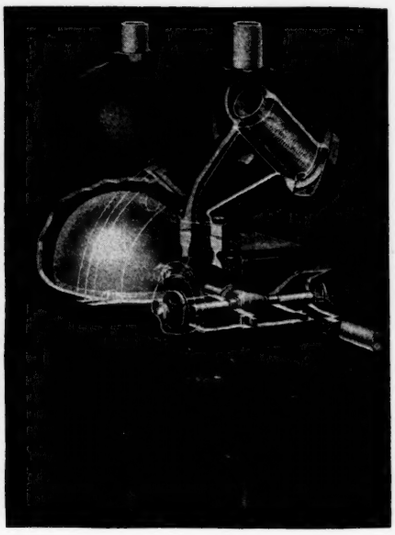
GRINNELL COMPANY INC.

Executive Offices: Providence, R. I.

Branches in all Principal Cities

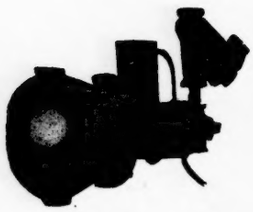


This trim installation of McDonnell No. 28 Self-Cleaning Duplex Feeders is in the Southern New England Telephone Co. Bldg., at Bridgeport, Conn. The heating contractor was W. P. Kirk Co. of Bridgeport.



There's nothing wrong with *this* picture!

{The McDonnell Feeders show that the engineer is in step with progress}



For Oil-Fired or Stoker-Fired Jobs

Here is an ingenious combination—the McDonnell No 30 Safety Feeder combined with the McDonnell No. 31 Emergency Switch. The feeder takes care of normal operation, and the switch takes care of foaming and priming. Entire combination costs little more than the feeder alone.

"To forget is human." That is why people forget the boiler water line. However, there is every indication that an ever-growing number of engineers are *not* forgetting to install the device that *never forgets.*

Each year brings increasing evidence that McDonnell Boiler Feeders are rapidly coming to be regarded as a standard part of the up-to-the-minute heating installation. The engineer who specifies them, proves that he is a long step ahead of the engineer or contractor who doesn't!

There is no longer any reason for limiting McDonnell protection to larger boilers. The McDonnell No. 30 Safety Feeder offers McDonnell dependability and quality in a moderate priced feeder that can be justified for even the smallest boilers. It is ideal for those who prefer a feeder that operates only when the boiler water line drops to the danger level—a modern practice that is advocated by many engineers in connection with moderate or small sized boilers.

Every hand-fired job needs McDonnell protection, and the automatic job fairly shouts for it. The comfort and convenience argument doesn't ring true where it's necessary to watch the boiler water line.

Are you fair to yourself and to those whom you serve, if you refuse to recognize the growing trend toward McDonnell protection for every boiler installation?

McDONNELL & MILLER
1314 Wrigley Building, Chicago
Eastern Office: Grand Central Terminal, New York

McDONNELL & MILLER
Boiler Feeders

"Doing one thing well"

Today's buildings are not modern without *MOIST AIR*

Ingenious Humidifying Radiator, remarkable forward step for health and comfort, offers sales opportunity to contractors and engineers

$150 to $225, f. o. b. factory, installation extra, in beautiful metal cabinet. Supplied also for recessing in wall. Water, fed in by the supply at the top, spreads out over the first section, overflows and spreads out over the second, and so on until the last section is reached. A drain carries away the small unevaporated surplus.

TO homes, it brings health protection and comfort for children, mother, and father. In factories and business buildings, it saves time lost from work. In schools and hospitals, it guards children's and patients' well-being. The Doherty-Brehm Humidifying Radiator, a simple, effective, and low-priced humidifier that fits into any steam, hot water, or vapor heating system, is the year's sensation in heating and air conditioning improvements.

Completely solves the parched air problem

This ingenious invention completely solves the problem of correctly moistened air in buildings with radiator heating. It brings remarkable new living comfort and health while adding very little to the building costs. Simple to install as an ordinary radiator, it banishes forever the dry air that threatens with colds, sinus troubles, mastoids, many winter ills. It cuts fuel costs, for overheating is no longer necessary for comfort. It solves many manufacturing problems.

One humidifies the average house

Install one of them in place of an ordinary radiator. The only extra piping needed is a water supply and a drain. One will humidify the equivalent of a house of up to 12 rooms, evaporating as high as 100 gallons of water daily, automatically regulating the amount to changing weather demands. Extra units take care of any size building. And it heats while it humidifies. One actually gives off more heat than an ordinary radiator of the same radiating surface.

Silent, attentionless . . . handsome cabinets

Since there are no moving parts to get out of order or to make noise, no fans, belts, or motors, it is silent and attentionless. No steam, no odor. Few articles of home equipment give so much . . . so unobtrusively . . . and at such little cost.

Even the cabinets have been worked out to meet every need. It is supplied in period wood cabinets to harmonize with finest furnishings. Or in metal cabinets. Or for recessing in the walls.

Sold on the CRANE *Budget Plan*

The Doherty-Brehm Radiator Humidifier is sold by **CRANE** through dependable heating and plumbing contractors everywhere. Your clients and customers can buy it under the **CRANE** Budget Plan and *pay only 10% down, the rest monthly.* To contractors, it offers a profitable new selling opportunity. Recommend it for new buildings and for modernizing old ones.

Mail coupon for File Book

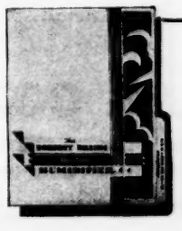
Every heating and ventilating engineer, contractor, and architect should have this book in his file. If you haven't it, mail the coupon at once.

DOHERTY-BREHM

HUMIDIFIER

SOLD BY

CRANE

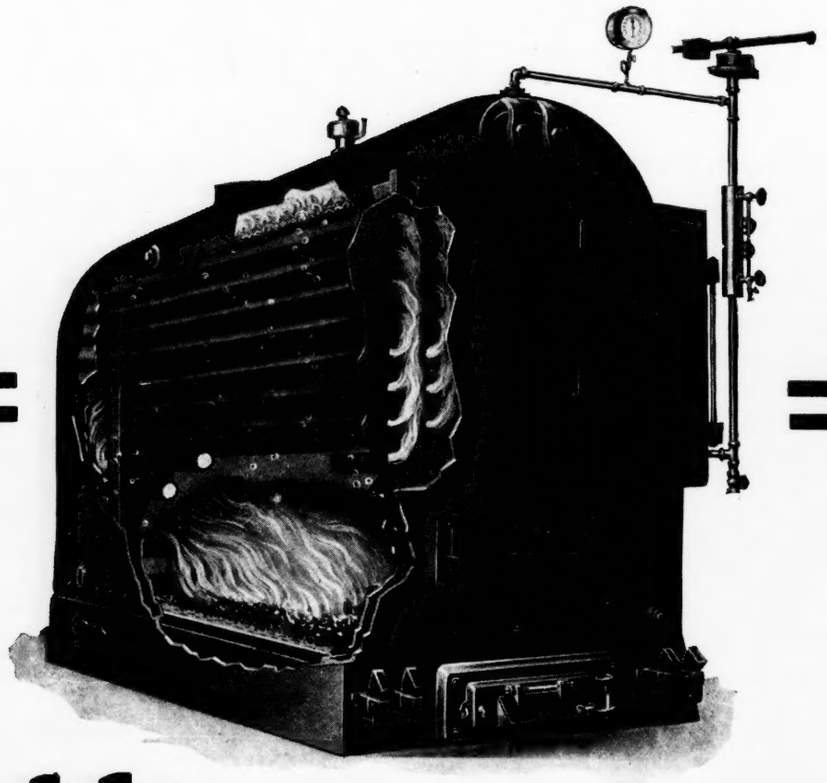


DOHERTY-BREHM CO.
333 North Michigan Ave., Chicago, Ill.
Please send your booklet about humidity and the Doherty-Brehm Radiator Humidifier, for my A. I. A. file.

Name .....

Address .....

MONCO



Reliable Steel Heating Boilers

Coal, Oil or Gas

MONCO Steel Heating Boilers can be relied upon to give satisfactory service. Superior quality and workmanship, combined with more than thirty years of boiler making, have raised **MONCO** Boilers to their present high standard. Designed according to the code of the A.S.M.E. Each boiler is inspected by a certified insurance inspector before shipment.

Write to us for complete specifications and details

Distinctive Features
make **MONCO** *Boilers highly adaptable to efficient use. Note the following:*

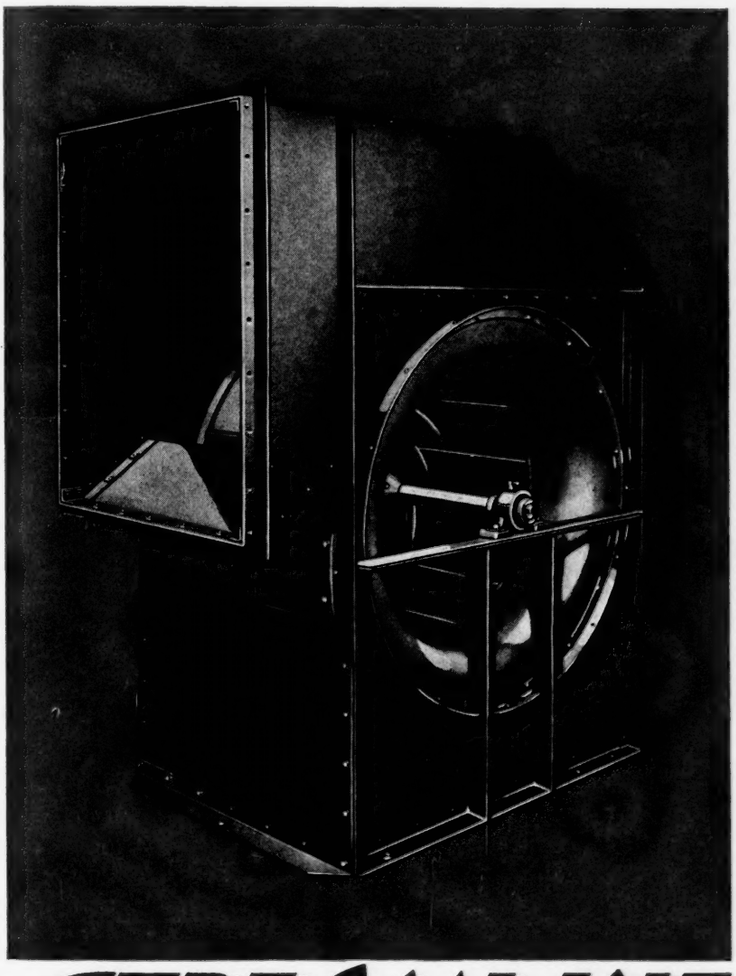
1. Arched self cleaning crown sheet.
2. Large combustion chamber.
3. Unrestricted circulation of water.
4. Low water line.
5. Large amount of direct heating surface.
6. Long three pass fire travel.

MONITOR BOILER CO., 1505 Race St., Philadelphia, Pa.

Affiliated with UNITED DRY DOCKS, INC., NEW YORK

Member of Steel Heating Boiler Institute

Increased Efficiency!



STREAMLINE
POWER FIXED
FANS

THE Streamline Power Fixed Fan will give you not only increased efficiency but combines with it unusually quiet operation. It operates efficiently at high speeds in direct connection with standard motors. It is scientifically designed. Sturdily built! Finely balanced! No rivets or projections on the wheel! Has non-overloading horse power characteristic and many other unique and unusual features. Is giving satisfactory service in many important installations. Send for Engineers' Data, Bulletin No. 65.

Our representative will call upon request

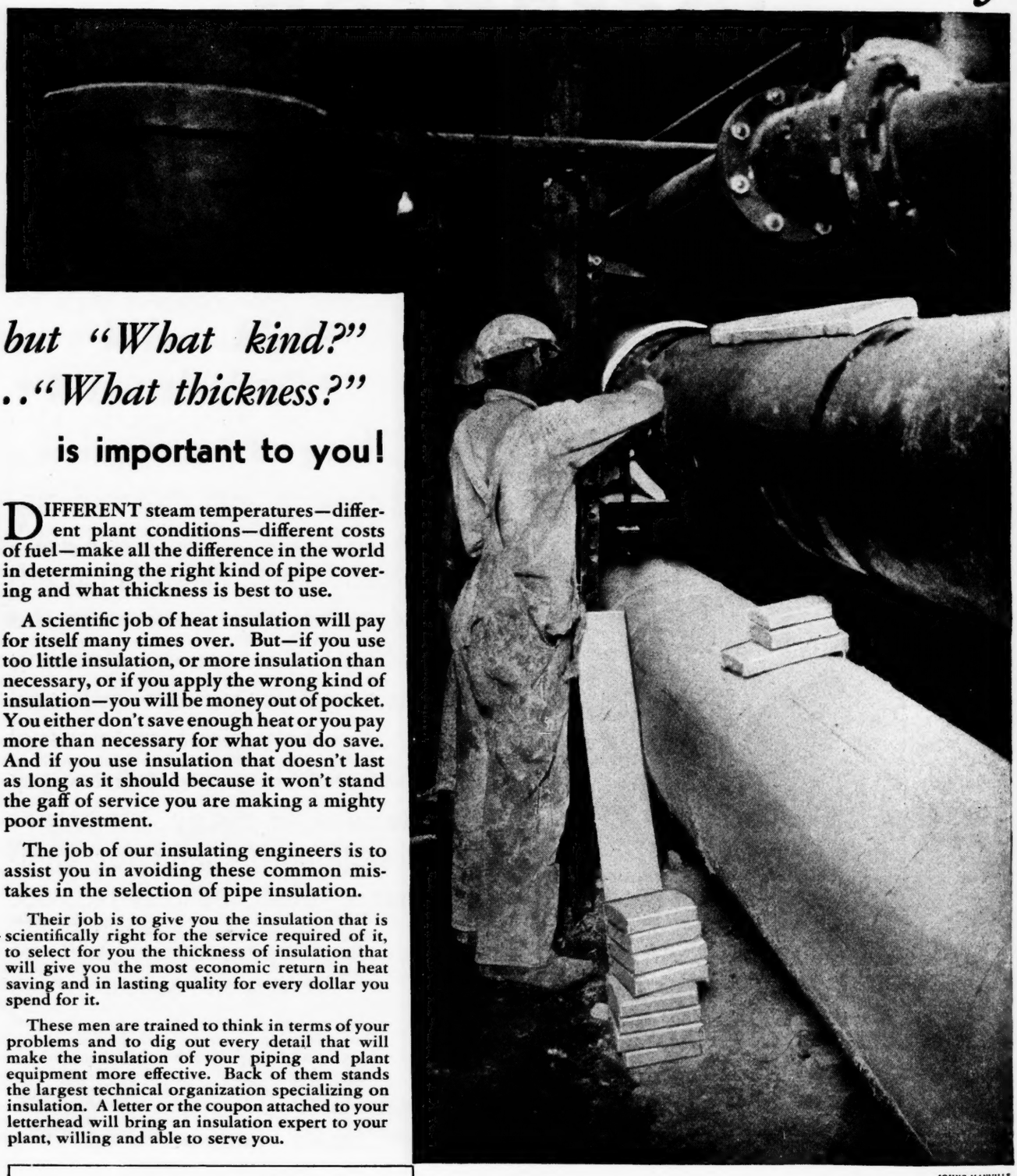
We Wish You a Merry Christmas and a Prosperous New Year

The Bishop and Babcock Sales Co.

GENERAL OFFICES *Cleveland, Ohio* 4901-15 HAMILTON AVE. N. E.

BRANCHES OR DISTRIBUTORS IN PRINCIPAL CITIES

PIPE INSULATION? . . . *Certainly*



but "What kind?" .."What thickness?"

is important to you!

DIFFERENT steam temperatures—different plant conditions—different costs of fuel—make all the difference in the world in determining the right kind of pipe covering and what thickness is best to use.

A scientific job of heat insulation will pay for itself many times over. But—if you use too little insulation, or more insulation than necessary, or if you apply the wrong kind of insulation—you will be money out of pocket. You either don't save enough heat or you pay more than necessary for what you do save. And if you use insulation that doesn't last as long as it should because it won't stand the gaff of service you are making a mighty poor investment.

The job of our insulating engineers is to assist you in avoiding these common mistakes in the selection of pipe insulation.

Their job is to give you the insulation that is scientifically right for the service required of it, to select for you the thickness of insulation that will give you the most economic return in heat saving and in lasting quality for every dollar you spend for it.

These men are trained to think in terms of your problems and to dig out every detail that will make the insulation of your piping and plant equipment more effective. Back of them stands the largest technical organization specializing on insulation. A letter or the coupon attached to your letterhead will bring an insulation expert to your plant, willing and able to serve you.

Address JOHNS-MANVILLE
At nearest office listed below
New York Chicago Cleveland New Orleans
San Francisco Toronto
(*Offices in all large cities*)

Please have a J-M Engineer call to discuss Insulation in our plant.

Name.....

Address.....

I-131-12

Johns-Manville

JOHNS-MANVILLE JM PRODUCTS

BARRIERS TO INDUSTRIAL WASTE

Insulations for all temperatures from 400° F. below zero to the highest industrial temperatures.

The J-M trade-mark is the stamp of quality on insulations, packings, refractory cements, asbestos and asphalt shingles, built-up roofing, industrial flooring, insulating board and numerous other products that have been developed to save money in the power plant.

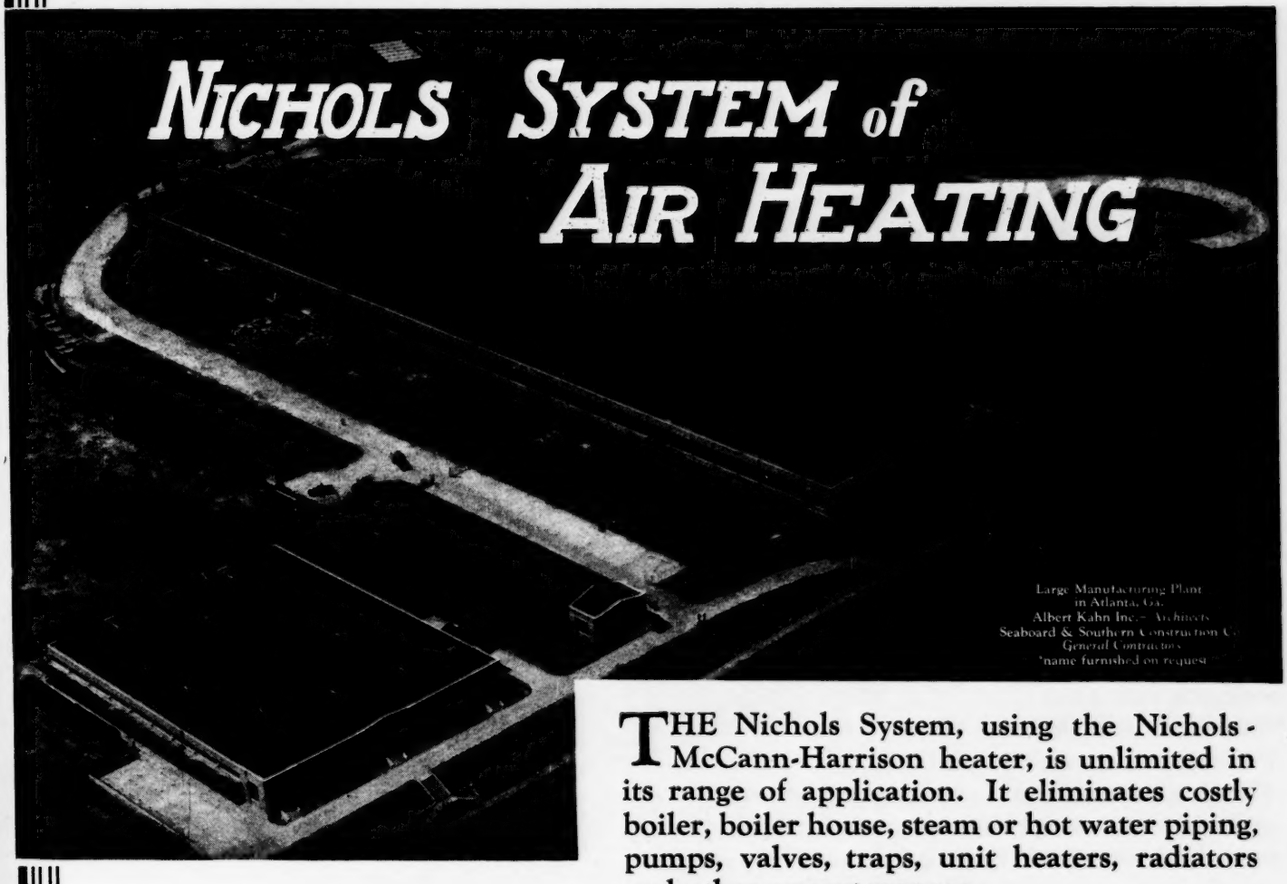
Better Heating *at Less Cost!*

NICHOLS AIR OIL or GAS FIRED HEATER SYSTEMS

Approved by National Board of Fire Underwriters

THE MODERN METHOD OF HEATING INDUSTRIAL BUILDINGS USING OIL OR GAS FUEL

This large automobile assembly and body plant, covering over 8 acres of floor space, is efficiently and economically heated with the



THE Nichols System, using the Nichols-McCann-Harrison heater, is unlimited in its range of application. It eliminates costly boiler, boiler house, steam or hot water piping, pumps, valves, traps, unit heaters, radiators and other appurtenances.

Send for Bulletin No. 106. It explains why it costs less to install and operate the Nichols System of Air Heating in buildings up to 600,000 sq. ft. of floor area.

NICHOLS PRODUCTS CORPORATION

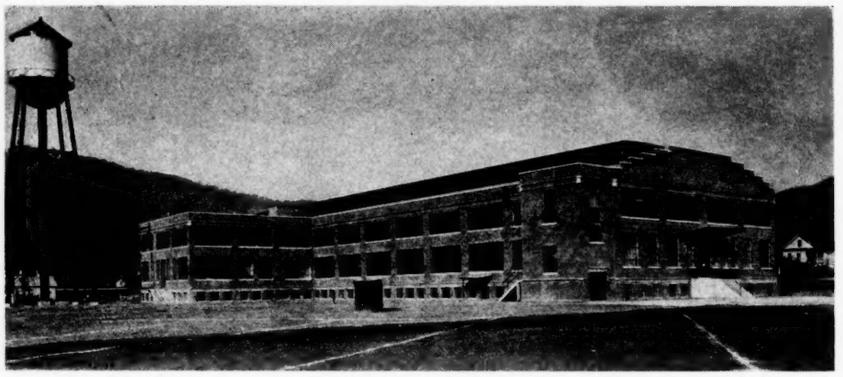
12953 GREELEY AVENUE, DETROIT, MICH.

Cleveland Pittsburgh New York—122 East 42nd St. Chicago Portland, Ore.

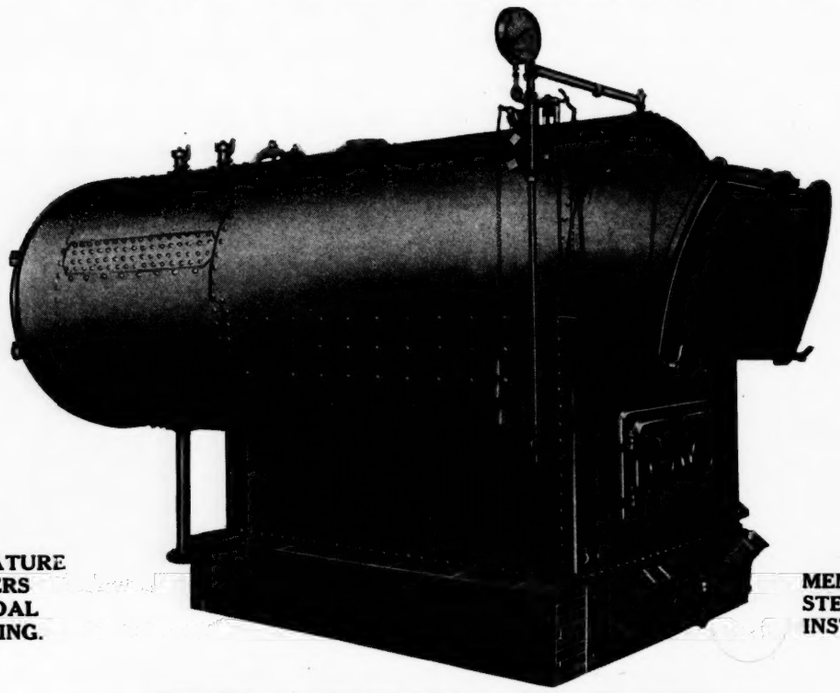
ROSS ENGINEERING OF CANADA, LTD., MONTREAL, CANADA

COATESVILLE BOILERS

COATESVILLE STEEL HEATING BOILERS



SYLVANIA PRODUCTS CO. PLANT—EMPORIUM, PA.



SEND FOR LITERATURE DESCRIBING BOILERS DESIGNED FOR COAL OIL AND GAS FIRING.

MEMBER OF THE STEEL HEATING BOILER INSTITUTE.

COATESVILLE BOILER WORKS

Boilers - Tanks - Steel Plate Work

Main Office and Works—COATESVILLE, PA.

Philadelphia 111 S. 15th St.
New York 30 Church St.
Newark 60 Park Place
Boston 141 Milk St.
New London 325 State St.
Pittsburgh Union Trust Bldg.
Syracuse, N. Y. 277 James St.
Baltimore Lexington Bldg.
Washington, D. C. 208 Evans Bldg.
Richmond, Va. Railway & Power Bldg.
Newport News, Va. 3100 Virginia Ave.
Bristol, Tenn.-Va. 607-609 State St.
Charlotte, N. C. 1717 East 7th Street
New Orleans 1811 Masonic Temple
Dallas, Texas 1505 North Haskell Ave.
Atlanta, Ga. Bona Allen Bldg.

He may need it only *once*...

To the most cautious pilots, to the most careful engineers and janitors, *accidents can happen.* Perhaps only once in a lifetime. But that possibility is enough to warrant using the most dependable safety devices—for planes and boilers alike.

Every low pressure heating boiler—regardless of the make or system—is subject to the danger of *accidental low water.* Carelessness, priming due to improper piping or dirt, or the failure of complex automatic devices are the causes . . . A cracked boiler is the result. The new Webster Boiler Protector is the preventative.

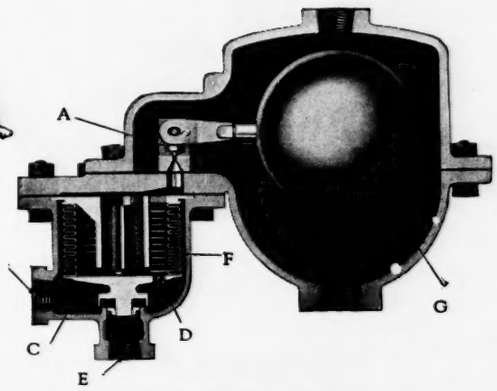
Positive Protection Against Low Water

For five full years this device has been in process of development, tested and retested under actual service conditions. The winter of 1929-30 saw nearly 100 installations subjected to every kind of use and abuse. Not until they came up to Webster standards in every detail of performance for an entire heating season were they offered to the trade as a Webster product.

For Every Type of Low Pressure System

The market for Webster Boiler Protectors is at every contractor's door. They can be sold in new as well as existing installations; in Webster Vacuum and Type "R" Systems; and in other vacuum, vapor and one-pipe installations. Every cracked or burned out boiler you repair means an easy and profitable sale of the Boiler Protector. Be the first in your locality to recommend, install and profit from this Webster Product.

The nearest Webster Branch Office is ready to give you detailed information and to supply your requirements immediately. Write or phone today.



Study this Construction

Here is how it works: Water main pressure is maintained in chamber C surrounding Sylphon Bellows F. Due to orifice opening D, this pressure normally exists also inside Bellows F. Pilot valve A is normally closed as float G is partially submerged below boiler water line.

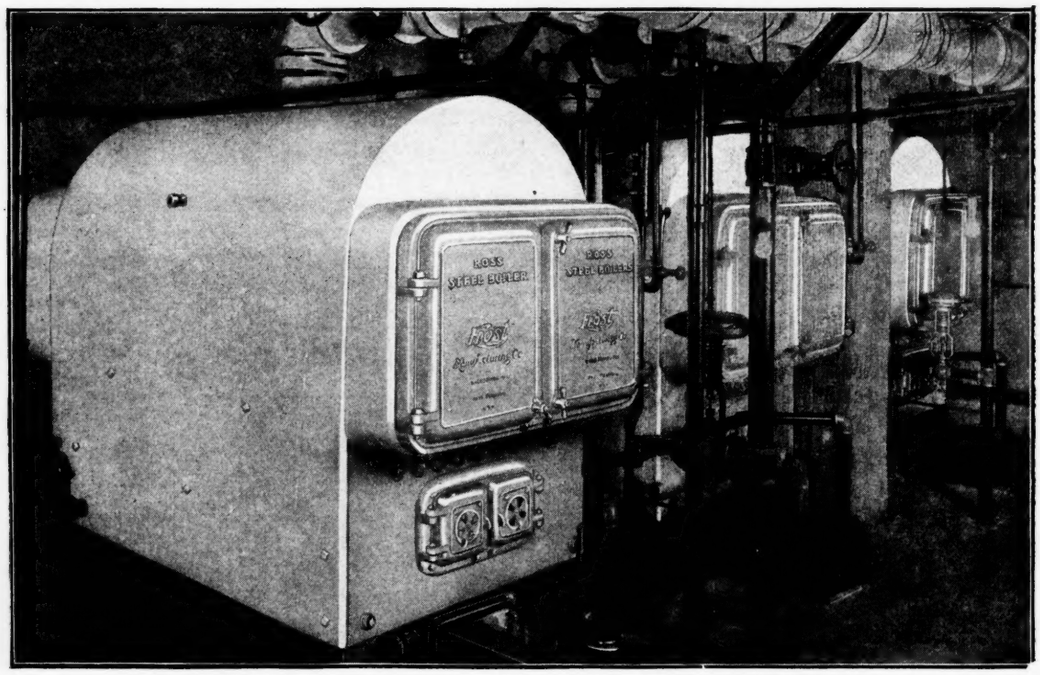
When water line falls and *protection is needed,* float G drops and opens pilot valve A. Water is then discharged through pilot valve A faster than it can flow in through orifice opening D and the pressure inside Sylphon Bellows F becomes less than that on the outside. This difference in pressure compresses Bellows F and raises water valve from its seat, causing a full flow of make-up water into boiler through connection E.

When water level is restored, float G rises to close pilot valve A. Pressure inside Sylphon Bellows F becomes equal to that outside and Bellows F extends to close water valve above connection E. Repeated severe tests show that this valve *simply cannot be stuck closed* because of the enormous power inherent in the design.

Warren Webster & Company, Camden, N. J.
Pioneers of the Vacuum System of Steam Heating
Branches in 60 principal U. S. Cities—Darling Bros., Ltd., Montreal, Canada
P-3

The New Webster Boiler Protector

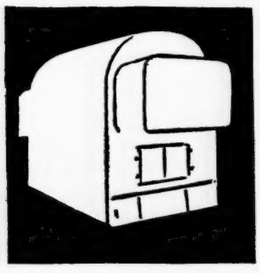
DEPENDABLE



Installation of three 9,000-foot Gas Fired Ross Steel Heating Boilers in the Albert Pike Hotel, Little Rock, Ark.; Eugene Stern, Architect; El Dorado Heating and Plumbing Co., Heating Contractors.

. . . . . In choosing a boiler the growing tendency amongst Architects and Owners is to regard dependability as the first requisite. . . . . The growing preference for Ross Boilers implies a high degree of heating efficiency.

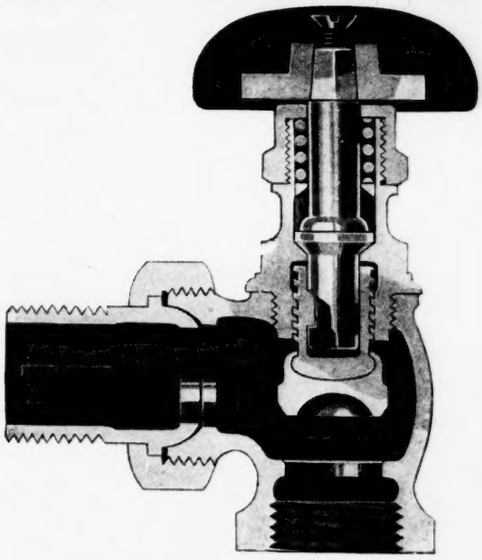
The FROST



ROSS STEEL HEATING BOILERS

FROST MANUFACTURING COMPANY
GALESBURG ILLINOIS

Marsh Re-enforced PACKLESS WATER Radiator Valves



Oval Wheel
or
Lock Shield

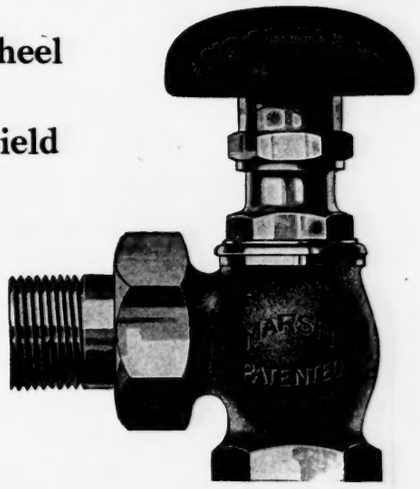


Fig. 137

These valves are quick opening, full pipe capacity, and are GUARANTEED NOT TO STICK AT ANY TIME, OR LEAK AT ANY PRESSURE that a cast iron boiler and radiation will stand.
We believe they are the only Packless valves which will hold high pressure forced circulation and also protect against taking in of air around stem in a sealed system, *two very necessary requirements* for satisfactory service and cost no more than the cheap competition valves. Get our prices.

Marsh Re-enforced GRADUATED WATER Radiator Valves

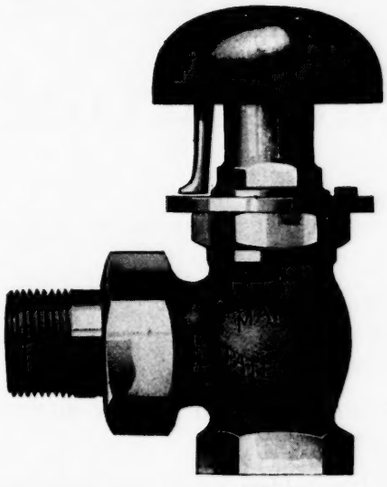


Fig. 139

Oval Wheel,
Lever Handle
or
Lock Shield

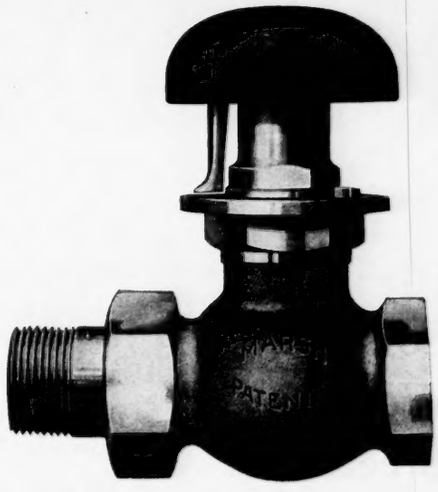


Fig. 239

With these GRADUATED Valves we regulate water heat temperature THROUGH VALVE, the same as for a vapor or vacuum steam system through a Modulating Valve. These are not only of material value for residence service, but we have tens of thousands in use for high pressure service in schools, hospitals and public buildings.

These valves cost but little more than our regular water valves and much less than steam modulated valves.

MARSH VALVE COMPANY

DUNKIRK **NEW YORK**

General Sales Distributors

Edward T. Hetherington
1709 Sansom St., Philadelphia

Appleton & Liptrott, Inc.
1480 Broadway, New York

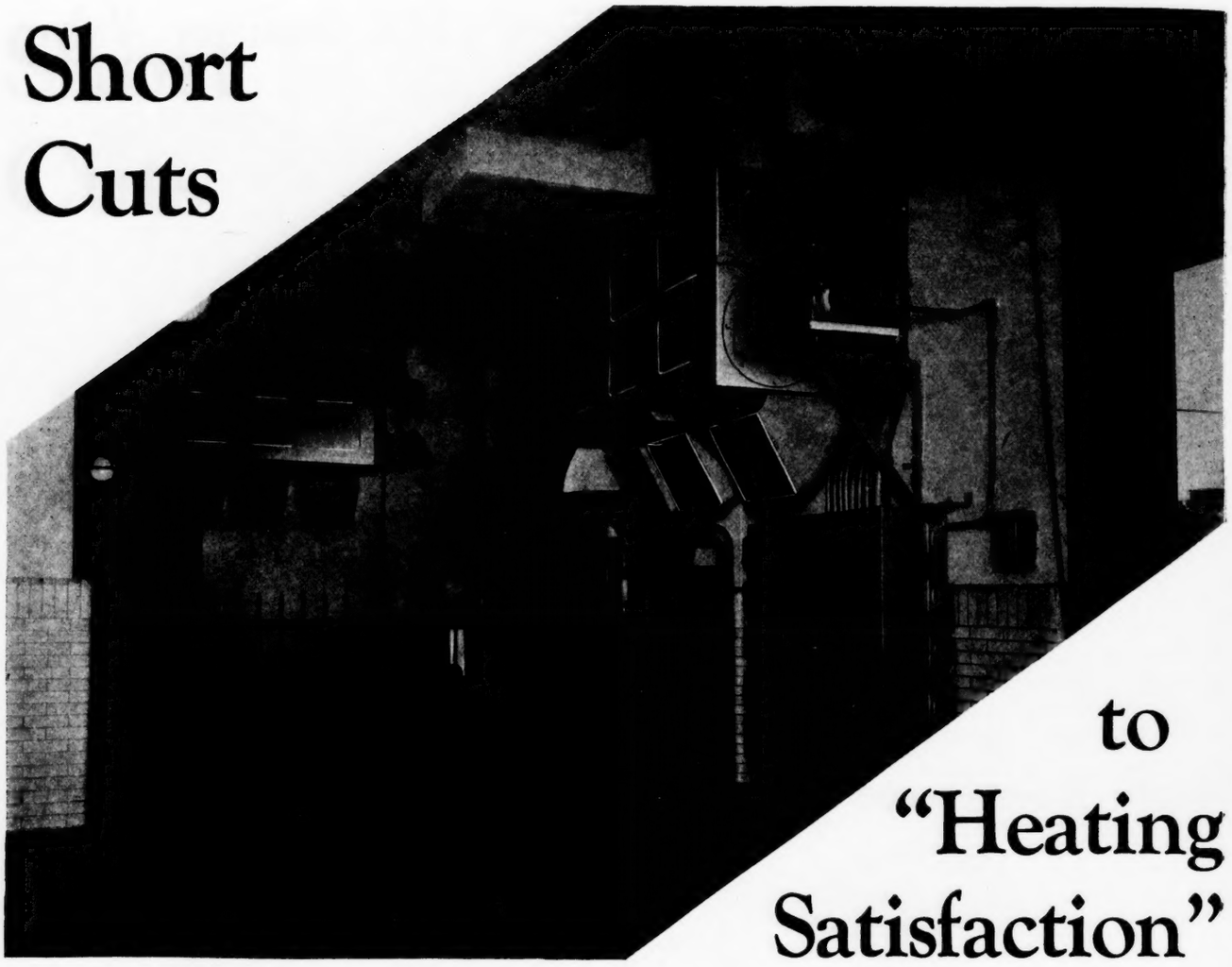
John W. Mabbs
431 So. Dearborn St., Chicago, Ill.

UNITED STATES RADIATOR CORP'N
General Offices: Detroit, Mich.

SARCO COMPANY, Inc.
183 Madison Ave., New York

Taylor-Forbes Company
Canadian Agents Guelph, Ont.

Short Cuts



to "Heating Satisfaction"

Inverted Lowboys in a large bus garage

Highboys
Lowboys
Wetboys
Breezo-fins
Gas Heaters

Complete details in our new Catalog 469

Save time and money by selecting Unit Heaters of *known* reputation for every job.

Where there is a question of the desirability of one type as against another, get the unbiased recommendation of a manufacturer who builds five complete lines.

When Buffalo Unit Heaters are installed you can be sure of complete user satisfaction.

Be sure to see our new Gas Fired Unit Heater at the National Power Show at New York, December 1st to 6th. Remember the booth numbers—413 and 414.

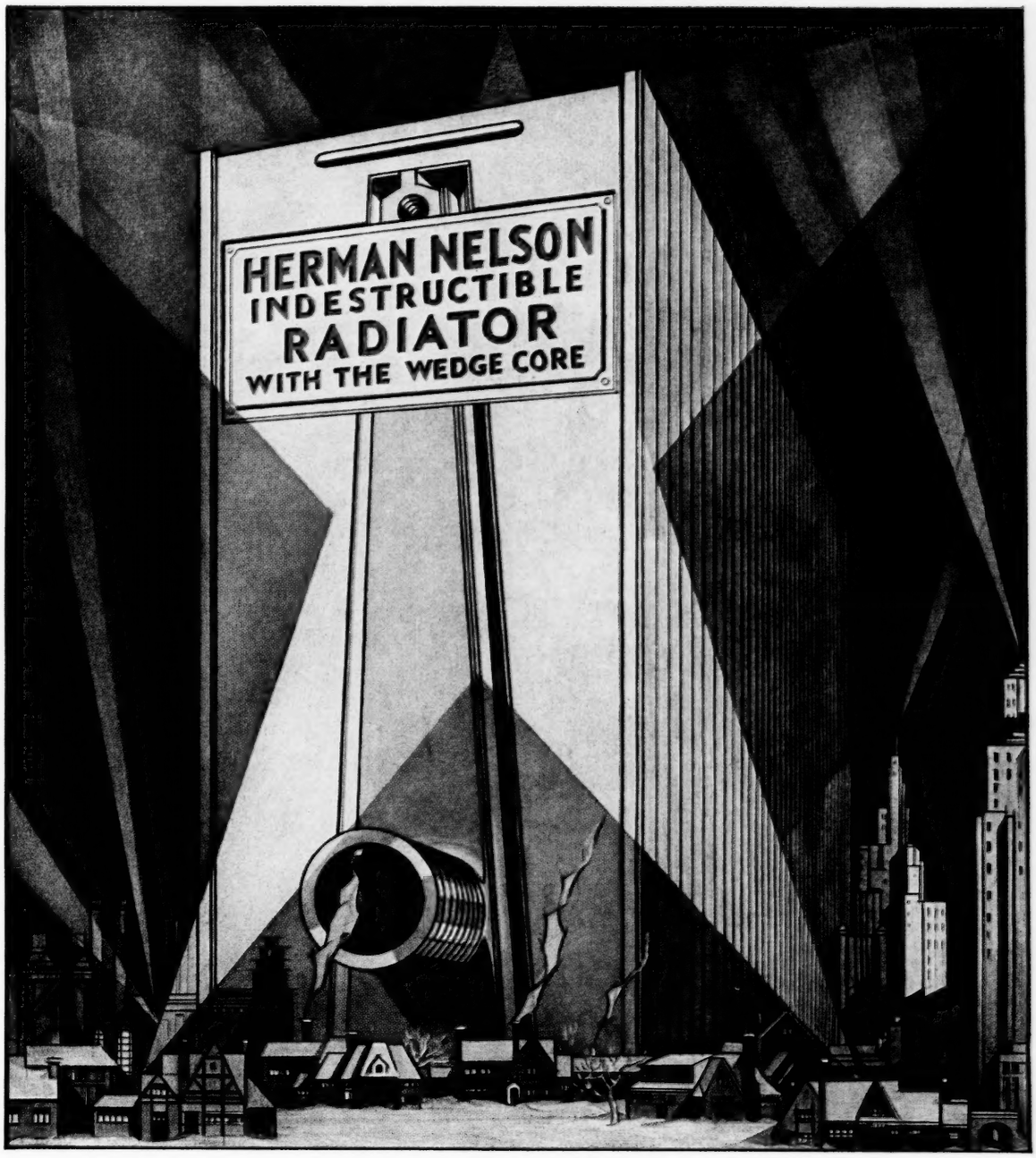
Buffalo Forge Company

480 Broadway Buffalo, N. Y.

In Canada: Canadian Blower & Forge Co., Ltd.
Kitchener, Ontario

"Buffalo"

UNIT HEATERS—*Steam or Gas*
For Every Requirement



OUR CONTRIBUTION TO THE ART OF HEATING AND VENTILATION

The Herman Nelson Wedge Core Radiator is an exclusive feature of all Herman Nelson Heating and Ventilating Products and accounts for their satisfactory performance. + + + +

THE HERMAN NELSON CORPORATION MOLINE ILLINOIS

BEHIND THAT GRILLE IN THE WALL

There are two ways to meet the large and growing demand for concealed heating. One is: to adapt any radiator to fit the problem at hand, in some haphazard manner. The other is: to supply a product specifically and scientifically designed for safe installation *within the wall.*

The success of the Herman Nelson Invisible Radiator is ample proof of the soundness of the latter method. Progressive heating contractors are finding it the means of getting profitable quality business.

The Herman Nelson Invisible Radiator comes enclosed in a specially designed steel cabinet which is easy to install in any four inch wall or partition. It is furnished either with or without removable front panel. It has no joints of any kind to fail and leak—no parts that can rust or get out of order. It eliminates "trouble jobs." Write for our engineering data book and full information. THE HERMAN NELSON CORPORATION, * Moline, Ill.

There's a radiator that says... "This home is modern"

HERMAN NELSON *Invisible* RADIATOR

BELFAST, ME.
BOSTON
SPRINGFIELD, MASS.
PROVIDENCE, R. I.
NEW YORK CITY
SYRACUSE
ALBANY
BUFFALO
PHILADELPHIA
SCRANTON

HARRISBURG
PITTSBURGH
JOHNSTOWN, PA.
WASHINGTON, D. C.
CHARLOTTE, N. C.
GRAND RAPIDS
SAGINAW, MICH.
FLINT, MICH.
DETROIT

CLEVELAND
CINCINNATI
TOLEDO
LOUISVILLE
INDIANAPOLIS
CHICAGO
PEORIA, ILL.
DES MOINES
MILWAUKEE

GREEN BAY
MINNEAPOLIS
DULUTH
ST. LOUIS
BIRMINGHAM
ATLANTA
NEW ORLEANS
MEMPHIS
DALLAS

OMAHA
EMPORIA, KAN.
KANSAS CITY
TULSA, OKLA.
DENVER
SALT LAKE CITY
BUTTE, MONT.
SPOKANE
PORTLAND, ORE.

SEATTLE
SAN FRANCISCO
VANCOUVER
TORONTO
WINNIPEG, MAN.
CALGARY
LONDON
OSLO
MELBOURNE
TOKIO, OSAKA

*Makers of the *Herman Nelson Invisible Radiator,* for residences, apartments, hotels, offices and monumental structures—the *Univent,* for the ventilation of schools, offices, churches and all buildings having an acute ventilating problem—the *Herman Nelson hiJet Heater,* for economical distribution of heat in factories, mills, garages, warehouses, and smaller buildings.

PLAIN TALKS ON OIL BURNER PROFITS

No. 8—Don't "Retrench"! Add New Profits Without Increasing Overhead:

When a well established heating and plumbing organization adds an Electrol Oil Burner Department, volume and profits grow faster than overhead. A recent survey of prosperous, fast-growing Electrol outlets throughout the country demonstrates this fact clearly. Many of these successful dealers have capitalized on enviable reputations as heating and plumbing organizations to also become important factors in oil burner merchandising.

Furman & Oles Cashed In

Furman & Oles, of Lewistown, Pa., are an example of what can be done to make good business better. Their firm name had been successfully established for many years. They had a substantial and growing business. Three years ago they expanded their organization to include an Electrol Oil Burner Department. Utilizing their original heating and plumbing set-up, this new department required only a minimum of additional sales and service expense. They rightfully expected increased prestige and volume without any substantial increase in overhead. And that is exactly what they got.

Today, with local competition from five other burners, Furman & Oles' Electrol sales have led them all by a wide margin. The return on their original investment in an oil burner department has been highly profitable and is on a definite upward trend.

The Same Opportunity Exists for You

There is no mystery in the success of such a plan as we now offer you. It is not difficult to sell an Oil Burner having the exclusive features enjoyed by Electrol. In addition, the margin of profit is most attractive.

For the Heating Contractor— a Profit Either Way

1. THE ELECTROL FRANCHISE. There's a nice profit in the Electrol Franchise for the Heating Contractor. This is abundantly proved by the success achieved by many leaders in the business.
2. THE ELECTROL COOPERATIVE PLAN. You will find the Electrol dealer in your territory prepared to make an attractive cooperative arrangement. One that adds to your income; safeguards your professional reputation and requires no extra investment. Let us give you details.

Member of the Oil Heating Institute

New York Office: 227 E. 45th St. *Factory:* ST. LOUIS

Branches

NEW YORK ST. LOUIS MINNEAPOLIS
BOSTON CHICAGO SEATTLE

ELECTROL

The OIL BURNER *with the Master Control*

227 East 45th Street, New York City

ELECTROL, INC., H
227 East 45th Street, New York
I would like to know more about—
The Electrol Franchise
The Electrol Cooperative Plan
Name
Address
City State

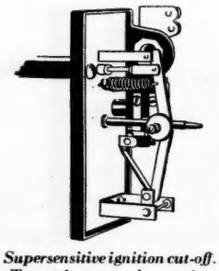
Born THAT WAY

PENN HEAT CONTROL was born with all the accumulated experience of burner controls that had gone before it or were contemporary with it. Before one part was cast for it, an exhaustive survey of heat controls was made, their bad points noted and their good points checked. Then all the bad points were eliminated and the good points improved upon. And the result was an entirely new, modern and improved control.

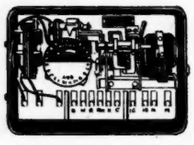
TELECHRON timing

The famous Telechron electric motor regulates Penn Heat Control instead of a customary timepiece that demands winding and constant attention. A supersensitive ignition cut-off, with 2 to 4 second operation, provides maximum safety under all operating conditions. An attractive room thermostat with day-and-night control insures a one-degree differential at all times, and patented pre-heat coils prevent lagging or overshooting of the room temperature. In addition, Penn Heat Control has in back of it the extensive, world-wide reputation of the General Electric Company for the manufacture of dependable parts and equipment, which guarantees it to be the finest equipment of its kind.

Yet with all its advantages, Penn Heat Control costs no more than other standard low-voltage controls. It is built more efficiently. It operates with greater economy. It is modern, improved.



Supersensitive ignition cut-off. Two to four second operation

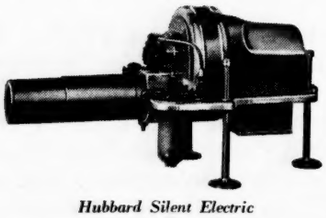


Timing mechanism with Telechron motor

On the HUBBARD *"Silent Electric"*

The HUBBARD "SILENT ELECTRIC" represents the more modern of oil burners. It is quiet, dependable and economical. And now, together with its many other advantages, contrived over a long period of experimentation, HUBBARD "SILENT ELECTRIC" comes equipped with Penn Heat Control. Manufacturers of more than fifty per cent of all the oil burners produced in the United States are using Penn Heat Control as standard or optional equipment.

Dealers are invited to make their own tests of Penn Heat Control. Communications should be addressed to the manufacturer or direct to Penn Heat Control Corporation. Communications with the latter should include the name of the burner. Advice is given at all times on heat control problems. Penn Heat Control Corporation, Franklin Trust Building, Philadelphia, Pennsylvania.



Hubbard Silent Electric

PENN HEAT CONTROL

OBC-13 *Listed as standard by the Underwriters' Laboratories*

over $3,000.00 saved monthly

Prior to the installation of Detroit Stokers the cost of producing heat alone in the Deshler-Wallick Hotel and American Insurance Union Office Building in Columbus, Ohio, in a representative month—February, 1929—was as follows:

Fuel cost	$6,600
Firemen	800
Total	$7,400

After the installation of Detroit Stokers under three 415 H. P. boilers serving both users jointly, the comparable cost in February, 1930, was as follows:

Coal	$3,380
Firemen	400
Total	$3,780

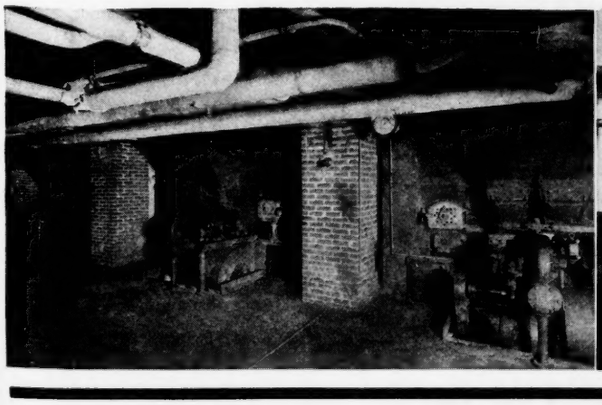
SAVING - - - - $3,620

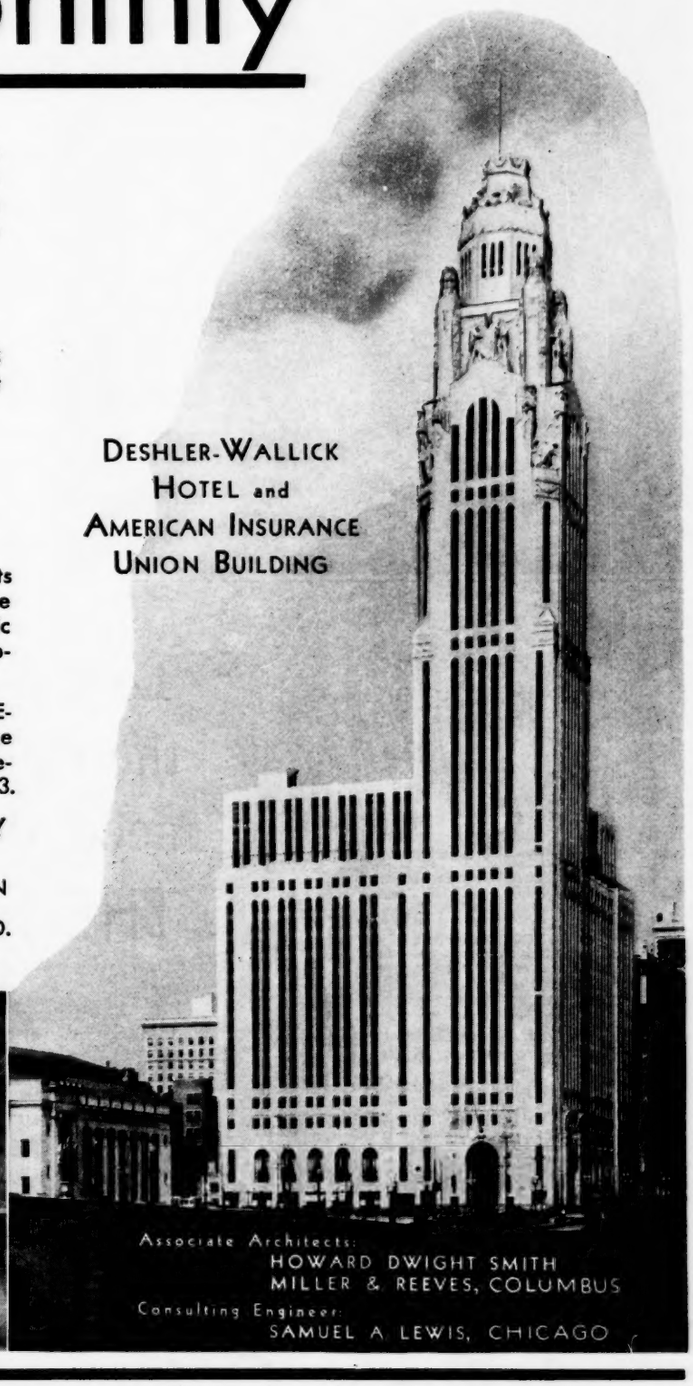
This saving of over $3000 a month applied to heating costs only. A further economy was effected subsequent to the installation of Detroit Stokers, through the use of electric generators, production of which amounted to 200,000 kilowatt-hours during February, 1930.

These economies were effected with Detroit DOUBLE RETORT Stokers—side cleaning stokers, built for heavy service and capable of carrying continuous high ratings. For detailed information on these stokers request Bulletin 473.

DETROIT STOKER COMPANY
THIRD FLOOR, GENERAL MOTORS BLDG.
DETROIT - - - MICHIGAN

In Canada: DETROIT STOKER COMPANY OF CANADA, LTD.
WINDSOR, ONTARIO



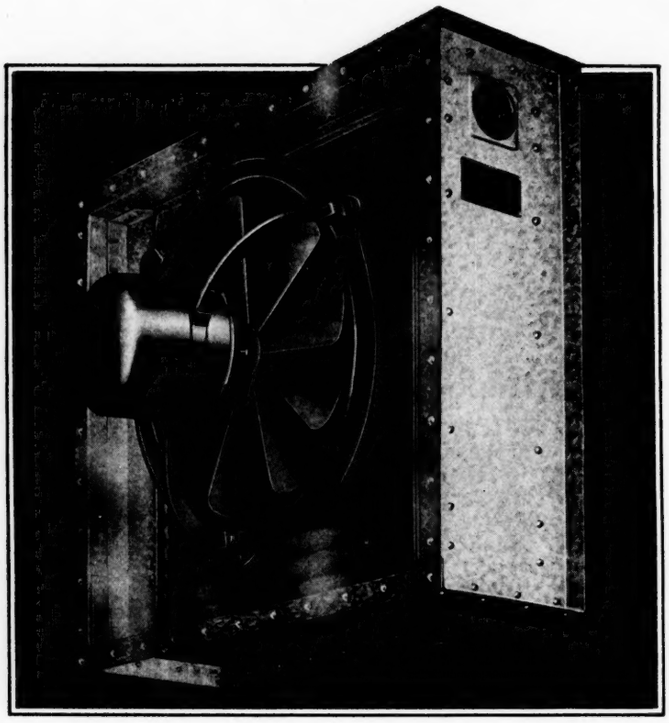


DESHLER-WALLICK HOTEL and AMERICAN INSURANCE UNION BUILDING

Associate Architects:
HOWARD DWIGHT SMITH
MILLER & REEVES, COLUMBUS
Consulting Engineer:
SAMUEL A. LEWIS, CHICAGO

DETROIT STOKERS

"HEAT WITH UNIT HEATERS"



of course!

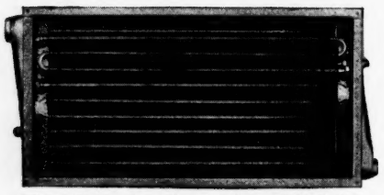
But whose to use?

Here's the answer!

To make sure that you select the right Unit Heater all you need do is make sure that THE HEAT-SURFACE IS

AEROFIN

(As standard for Unit Heaters as for all other Fan System Service)



The Standardized Light-Weight Fan System Heat-Surface

4 Types 196 Standard Sizes

Pressures up to 350 lbs. gauge

Unit illustrated in section is

UNIVERSAL AEROFIN, *2½ to 200 lbs.*

Any Office will gladly render prompt, efficient, technical cooperation

Newark will be glad to send informative and appropriate publications upon request.★

AEROFIN CORPORATION

850 Frelinghuysen Avenue, NEWARK, N. J.

Burnham Bldg. CHICAGO

11 West 42nd Street, NEW YORK

United Artists Building DETROIT

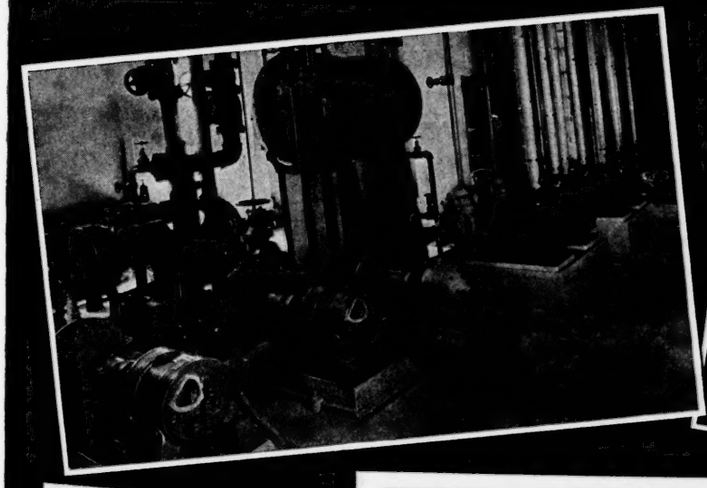
Land Title Bldg. PHILADELPHIA

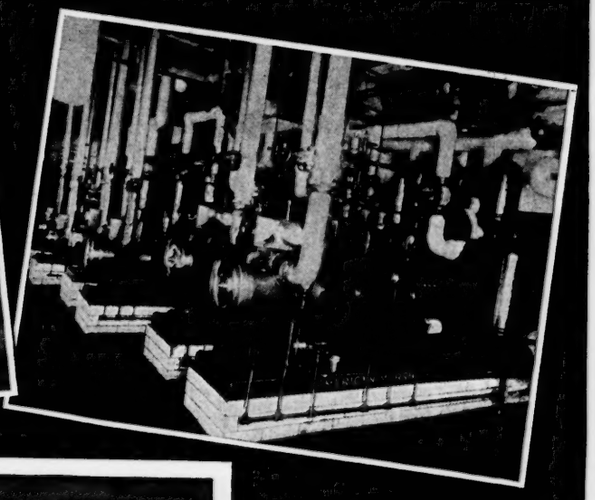
AEROFIN is sold only by Manufacturers of Nationally Advertised Fan System Apparatus.

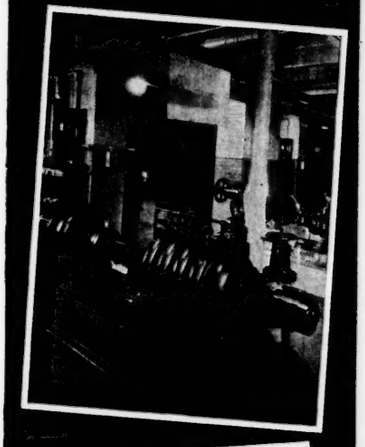
List upon Request

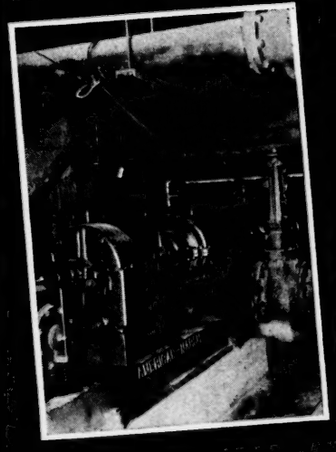
★*Please mention where you saw this advertisement.*

Brutes for Punishment





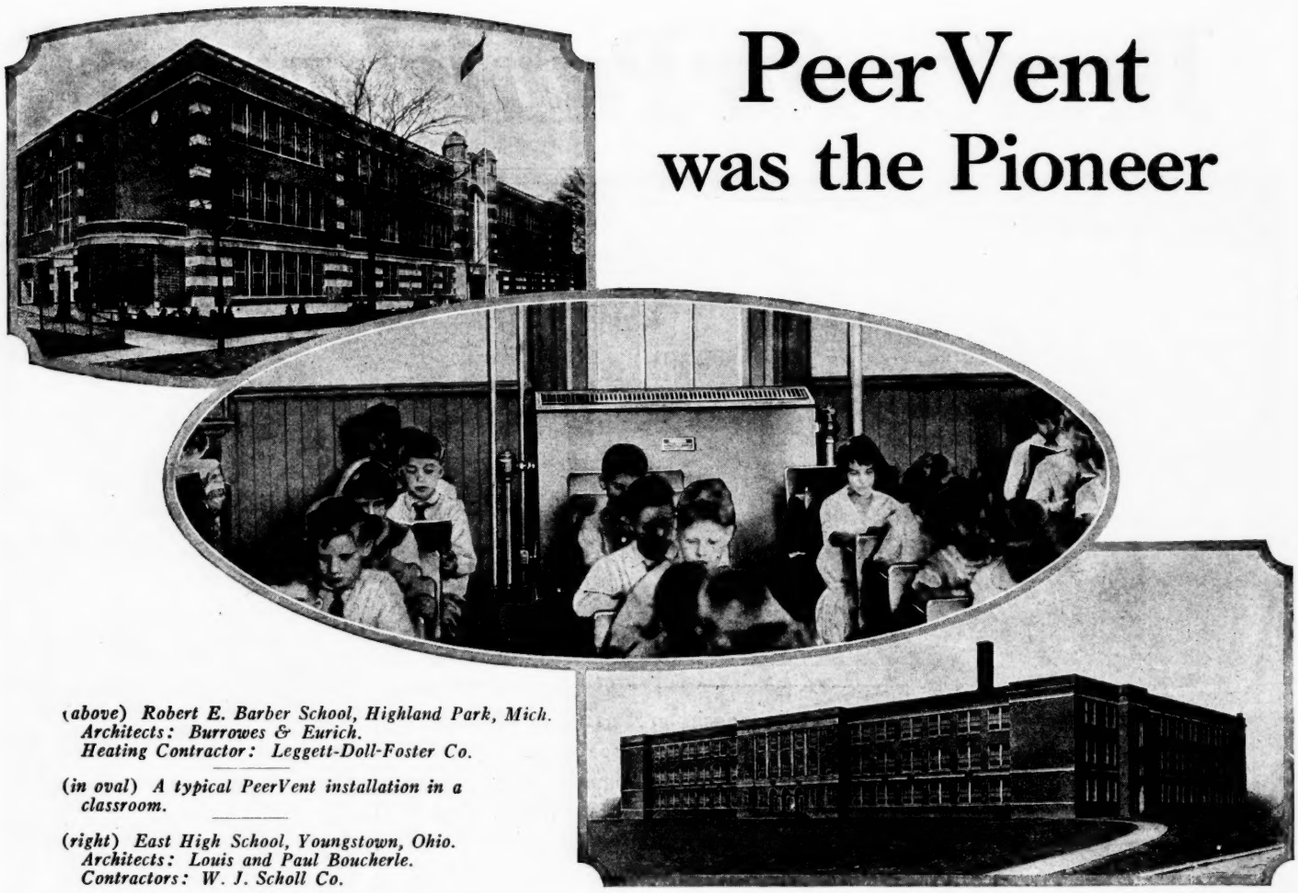




AMERICAN MARSH

CENTRIFUGAL and STEAM PUMPS

PeerVent was the Pioneer



(above) Robert E. Barber School, Highland Park, Mich.
Architects: Burrowes & Eurich.
Heating Contractor: Leggett-Doll-Foster Co.

(in oval) A typical PeerVent installation in a classroom.

(right) East High School, Youngstown, Ohio.
Architects: Louis and Paul Boucherle.
Contractors: W. J. Scholl Co.

PeerVent should be used not only in schools but in such other public or semi-public buildings as theatres, department stores, hotels, churches, banks, auditoriums, offices, etc., where large numbers of people gather and where extreme conditions for heating and ventilating exist.

PEERVENTS installed 19 years ago still give satisfactory and efficient service. These first units were then based on 22 years of experience in the heating and ventilating field. The PeerVent of today employs the same basic principles but the recent models are greatly improved in construction and mechanical excellence — better radiator, better fans, better motors, etc. Peerless is always a little in advance with improvements.

PeerVents are constructed on sound engineering principles, are exceptionally well built and absolutely noiseless in operation.

The PeerVent Heating and Ventilating Unit fully meets all requirements of the most stringent State and municipal codes covering the ventilation of school buildings.

Write for the Peerless catalog describing and illustrating PeerVents.

PEERVENT

PEERLESS UNIT VENTILATION CO., Inc.
BRIDGEPORT, CONNECTICUT
Pioneers in Unit Ventilation
Resident Engineers in Principal Cities from Coast to Coast

THE HEAT IN THIS ENTIRE BUILDING

(22,000 SQUARE FEET OF RADIATION)

IS CONTROLLED BY THE

OUTDOOR TEMPERATURE

WITH ONLY ONE

SIMPLE

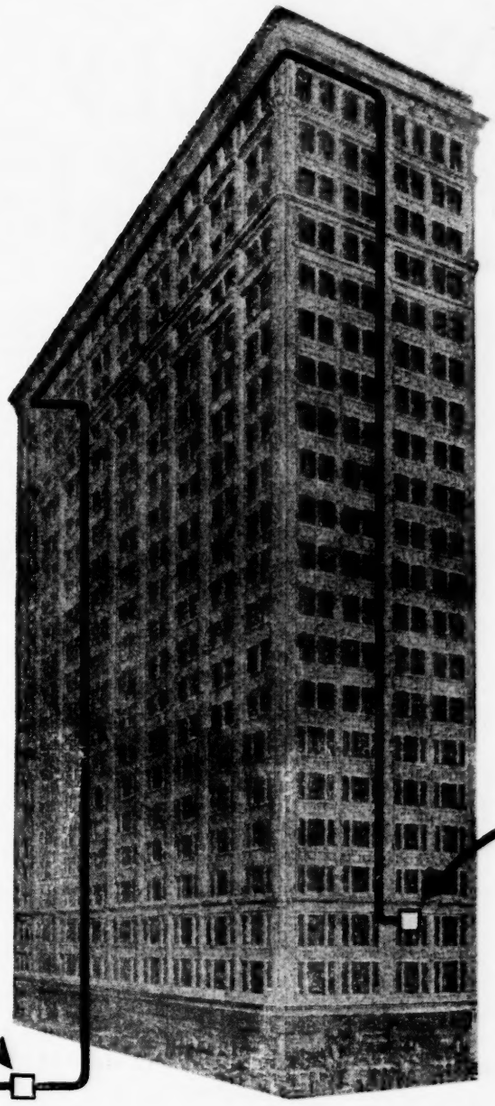
DUO-STAT

AND ONE

Raymond

Motor Operated

Steam Valve

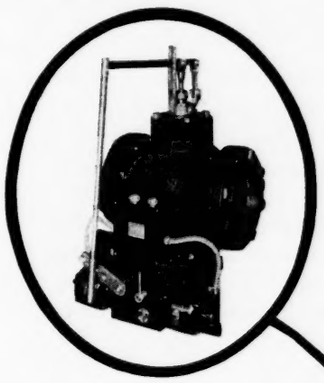


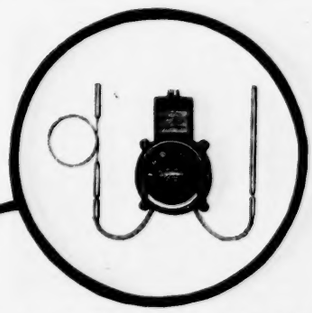
Consumers Building Chicago

In the Consumers Building, shown at the left, a single DUO-STAT controlling the entire steam supply has effected a net steam saving of over 40% and is, at the same time, giving accurate temperature control throughout the building.

The temperature of the condensation from the heating system has been reduced to approximately 100 degrees, which in itself is a creditable achievement. Troubles due to leaky traps are entirely eliminated.

Shown below is the Motor Operated Steam Valve controlled by the DUO-STAT. This valve controls the entire steam supply to the heating system in this building.





Shown above is the DUO-STAT which is located on the third floor. An electric circuit runs from the DUO-STAT to the Motor Operated Steam Valve in the basement.

Steam for the Consumers Building is supplied by the Illinois Maintenance Co.

Apparatus Required

For a building the size of the Consumers Building only one DUO-STAT and one Motor Operated Steam Valve are actually required to control the entire heating system. However, a small control panel for the Engineer's office is usually included.

In larger buildings it is often desirable to divide the building up into several zones and control each zone as a unit with a separate DUO-STAT and Steam Valve. In the Chicago Daily News Building (apparatus now being installed) there will be nine DUO-STATS controlling nine separate zones.

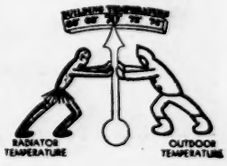
STEAM SAVINGS 25 TO 40%

Data collected from DUO-STAT installations all over the country indicate an average steam saving of 25% and in many cases as high as 50%. These savings are made possible because the DUO-STAT controls a heating system so accurately there is no waste of steam in overheating. The amount of heat put into a building is governed solely by the weather.

F. I. RAYMOND COMPANY

629 West Washington Blvd. - CHICAGO

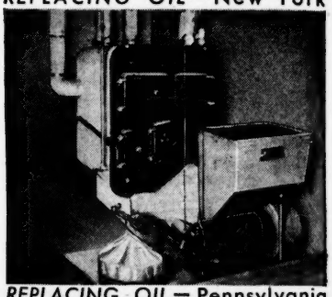
Write for Bulletin No. 3 which describes this unusual apparatus.



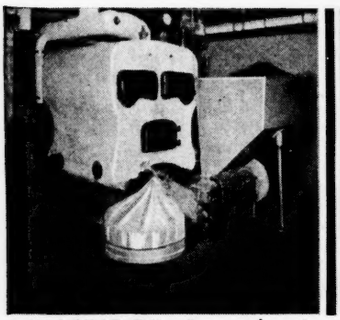
Make Automatic Heat WHOLLY Enjoyable

AUTOMATIC ANTHRACITE HEAT

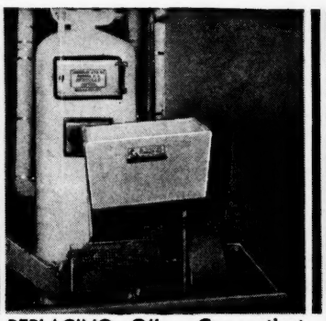
REPLACING OIL—New York



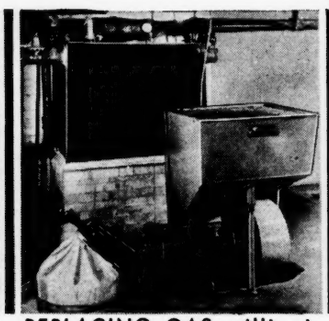
REPLACING OIL—Pennsylvania



REPLACING OIL—Pennsylvania



REPLACING OIL—Connecticut

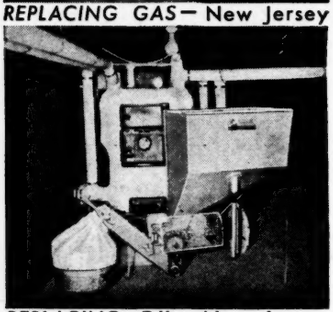


REPLACING GAS—Illinois

REPLACING GAS—New Jersey

REPLACING OIL—New Jersey

REPLACING GAS—New Jersey



REPLACING OIL—New Jersey

MANY of the thousands of Electric Furnace-Man installations have *converted* gas and oil burners *to automatic anthracite.* What greater, more definite proof can be shown of the advantages of anthracite as modernized by the Electric Furnace-Man!

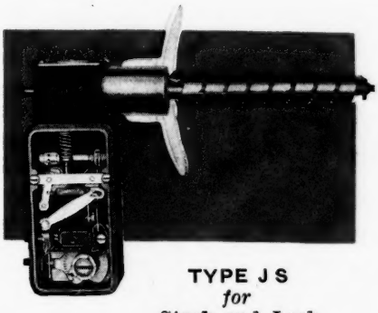
These home owners experienced the advantages of automatic heat with "substitute" fuels. But to get the *safety, cleanliness,* and *economy* that makes automatic heat *wholly* enjoyable, they *replaced "substitutes" with automatic anthracite — anthracite modernized* by the Electric Furnace-Man.

The Electric Furnace-Man is the outstanding domestic coal burner. Its leadership in the field is evidenced by thousands of satisfactory installations that testify to its efficiency and reliability. You can recommend the Electric Furnace-Man for any domestic heating job with absolute confidence. Authorized distributors and dealers of the Electric Furnace-Man in over 350 cities will be glad to cooperate and furnish estimates.

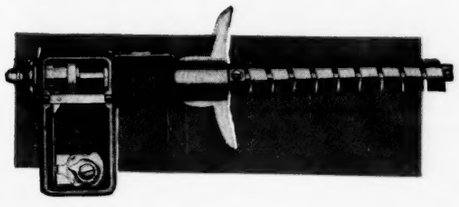
DOMESTIC STOKER COMPANY
7 Dey Street New York

The Electric Furnace-Man

(Patented Automatic Coal Burner)

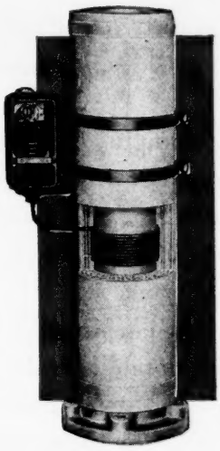


TYPE J S
for
Stack and Lock
Safety Control

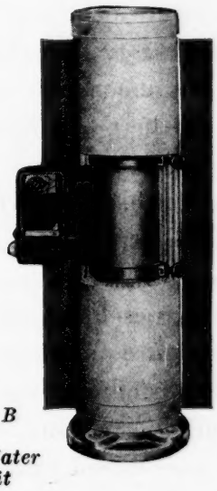


TYPE J
MODEL J R H
for
Furnace Safety Limit
or Fan Control

TYPE J
MODEL J R P
for Steam Pressure
Safety Limit



TYPE J
MODEL J R T
for
Hot Water
Safety Limit



TYPE J
MODEL J R B
for
Surface Hot Water
Safety Limit

PENN

has set a NEW Standard of Simplicity and Low Cost for ~

OIL BURNER CONTROLS

THE fundamental basis of this new series of Penn Automatic Controls for Oil Burners is the patented Penn Magnet Structure. Sensitive, yet it handles enormous loads without the use of fragile mercury tubes, and has been proven outstandingly successful on many thousands of Penn Controls. »

By incorporating the magnet structure in this complete line of oil burner controls, The Penn Electric Switch Company has set a new standard of simplicity, which has made possible new economy without sacrificing quality. Materials are of the highest grade. Workmanship of the first order. » »

We gladly place the complete facilities of the Penn Laboratories at your disposal in working out problems pertaining to automatic heating! Feel free to write at all times. » » » » » » » » »

PENN ELECTRIC SWITCH CO.

DES MOINES, IOWA

A Complete Line of Automatic Electric Switches for
Oil Burners Unit Heaters Gas and Electric Heaters Pumps
Air Compressors

CARRIER ANNOUNCES

PHARMACEUTICALS RAILWAY CARS PUBLIC BUILDINGS SHIPS OFFICE BUILDINGS

GREAT CHANGES are under way in the business of air. Railroad diners were successfully air-conditioned for the first time this year. Quick-freezing of foods and their preservation for marketing have raised a host of new problems in refrigeration. Extensive factory remodeling has stirred a widespread interest in unit-heating.

To cope successfully with these rapidly changing conditions—to offer architects, engineers, manufacturers, and owners the most recent and most authoritative information in the allied fields of heating, cooling, refrigeration and air-conditioning—the Carrier Corporation has been formed.

Three companies are combined in the new corporation. Each has back of it years of pioneering, research, development and service.

The engineers of the Carrier Engineering Corporation have pioneered the development of air-conditioning for industrial and comfort uses for more than a quarter of a century. Their record of more than 3000 installations of Manufactured Weather in more than 200 types of business is evidence of their success.

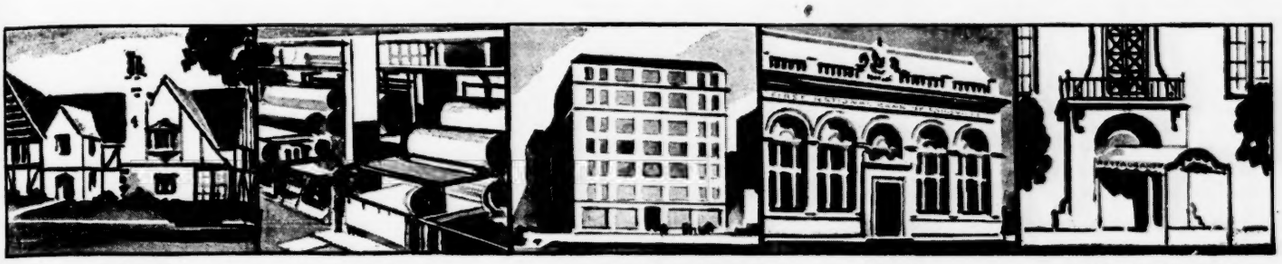
The Brunswick-Kroeschell Company has been developing and perfecting refrigeration equipment since the days when ice was the only refrigerating method accepted.

The York Heating & Ventilating Corporation has been a leader in the now widespread practice of using unit-heaters for factory heating.

The Carrier Corporation merges the engineering resources, research and manufacturing of these three companies. It joins under unified management three manufacturing, sales and service organizations prepared to pass on to architects, engineers, building owners and industries, the multiple benefits of such consolidation. Carrier Corporation, Newark, N. J. Branches in principal cities throughout the world.

Carrier Corporation

Weathermakers to the World



HOMES PRINTING DEPARTMENT STORES BANKS RESTAURANTS

A NEW *world-wide service*

DELICATESSEN FOODS TOBACCO HOTELS TEXTILES

in Air Conditioning

UNIT-HEATING AND COOLING AND REFRIGERATION

The Carrier Corporation combines

CARRIER ENGINEERING CORPORATION

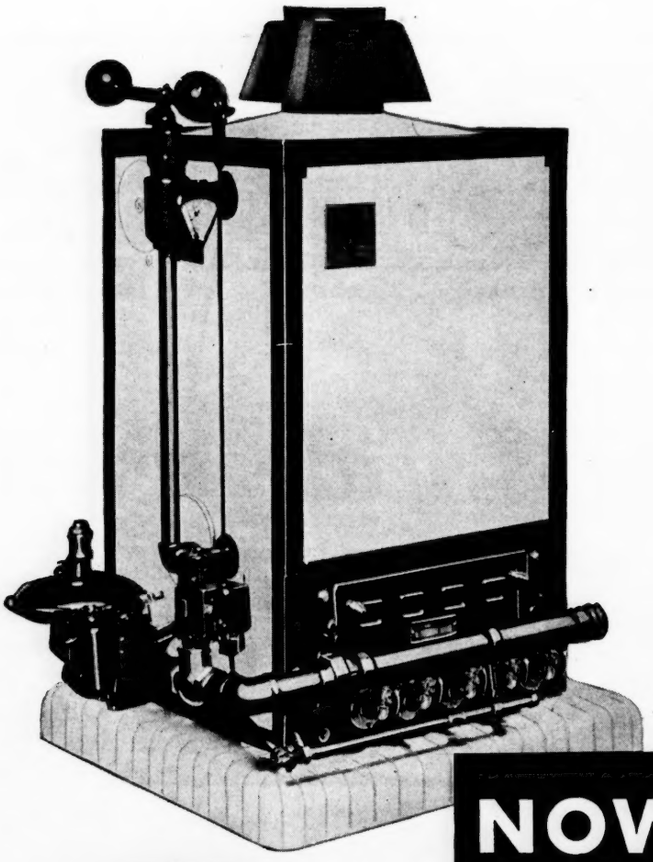
Originators of Manufactured Weather for weather-sensitive manufacturing processes in more than 200 types of industry and for personal comfort in more than a dozen varied business fields. Makers of Carrier Centrifugal Refrigeration Machines, Driers and Vapor Degreasers. The Carrier Engineering Corporation either controls or has an interest in the Carrier Construction Company, the W. J. Gamble Corporation, the Leather Equipment Company, Inc., the Carrier Engineering Company, Ltd., of London, the Carrier-Ross Engineering Company of London, the Cärrier Lufttechnische Gesellschaft of Stuttgart and the Carrier-Lyle Corporation, which offers the Weathermaker for the home.

BRUNSWICK-KROESCHELL COMPANY

Makers of refrigeration machines for all kinds of business and industry. Leading maker of marine refrigeration equipment, having equipped more than 3000 American ships.

YORK HEATING & VENTILATING CORPORATION

Pioneer makers of York Heat-Diffusing Units for all types of industrial plants and factories. Makers of York and Kroy Air-Cooling Units.



NOW is the time to SELL

IDEAL GAS BOILERS

★ The last word in automatic heating—Ideal Gas Boilers carry all the prestige of American Radiator Company—a fact that appeals instantly to every prospect.

Christmas is coming—and banks are preparing to pay out 600 million dollars in Christmas Club Funds. Savings bank accounts are 260 million dollars ahead of last year. This is the season for spending, but not a time for useless spending—rather a time for investing in useful, value-giving products.

After every business depression, increase in residential building has always meant the beginning of returning prosperity. And that increase has already started. In November, which is normally the smallest month of the year in building permits, the permits were far ahead of October.

That is just another reason why this is the time to concentrate on Ideal Gas Boiler sales. We'll be glad to give you free merchandising helps if you will ask for them.

Manufactured by

AMERICAN RADIATOR COMPANY

Division of

AMERICAN RADIATOR & STANDARD SANITARY CORPORATION

40 West 40th Street, New York

Every Piece Hydraulically Tested

SOUND SPECIFICATION

The name "Spang" on your heating and plumbing pipe requisitions is the soundest guarantee for long-lasting service and satisfaction you can possibly obtain. Every length is backed by the skill and care of America's longest established pipe mill where pipe making has been a mastercraft for over half a century.

Every piece pressure tested—cleanly threaded—easy to cut and safe to bend . . . these are the outstanding qualifications that make "Spang" a preferred brand among plumbing and heating contractors everywhere.

SPANG, CHALFANT & CO., INC.

General Offices: CLARK BUILDING, PITTSBURGH, PA.

Sales Offices: CHICAGO, ILL. NEW YORK, N. Y. ST. LOUIS, MO. PITTSBURGH, PA. TULSA, OKLA. LOS ANGELES, CAL.
Welded Mills: ETNA, PENNA. SHARPSBURG, PENNA. *Seamless Mills:* AMBRIDGE, PENNA.

SPANG

WELDED STEEL PIPE

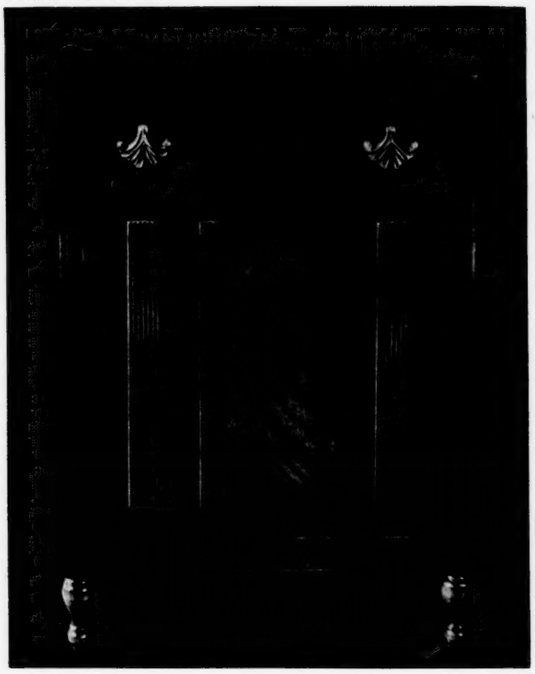
A CHECK LIST
for Air Conditioning
Primary Factors

- ✓ *Evaporation of water.*
- ✓ *Diffusion of moisture particles.*
- ✓ *Washing air free from impurities.*
- ✓ *Recirculation of air.*
- ✓ *Control of relative humidity.*

INSIST ON THE **COMPLETE JOB**-WELL DONE

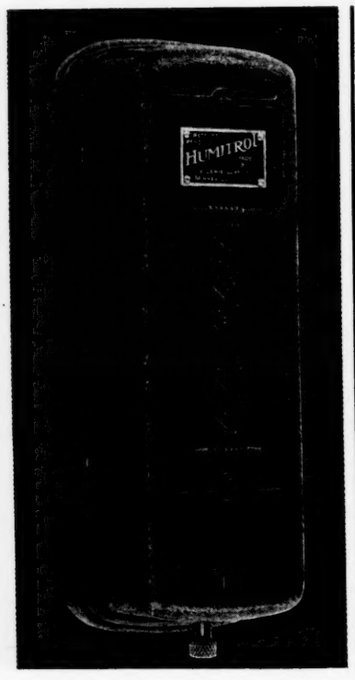
Air conditioning involves many factors. Discharging moisture is only one. To accept less than complete and automatically controlled conditioning of heated air is to make an unnecessary compromise.

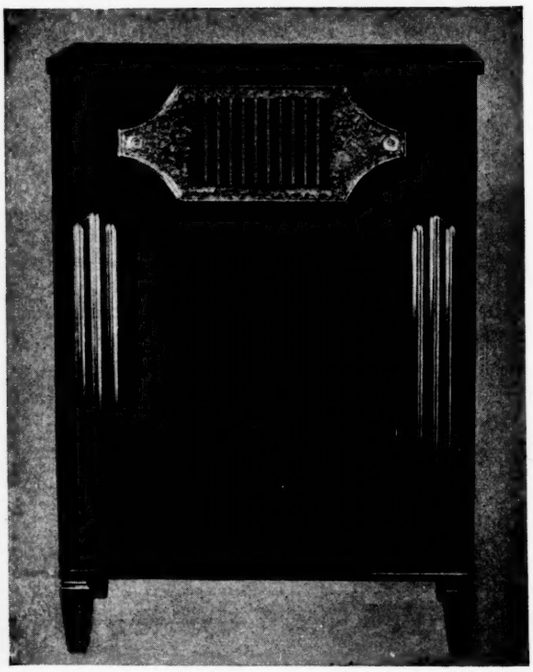
Lewis Air Conditioners offer an efficient solution to the entire problem. They provide rapid evaporation with low water consumption. Moisture is released in a vaporous form with complete diffusion, no free particles. All air is washed free from dirt, dust and impurities as it passes through the humidifying section. Through forced recirculation, humidity is uniformly maintained throughout the house. With the patented Lewis Humitrol the entire system is placed under automatic control with relative humidity held at whatever percentage is desired.



THE HUMITROL

The patented Lewis Humitrol looks like a thermostat — acts like one. You merely set the Humitrol for the relative humidity you wish to maintain. This automatically governs the operation of the Lewis Air Conditioner.





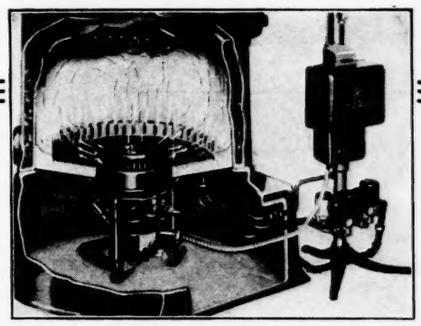
TWO BEAUTIFUL NEW ENCLOSURES

Lewis conditioners may be housed in attractive cabinets of either wood or steel, they may be concealed in the wall to conform with modern concealed radiation, or they may be installed in the basement with duct work to upstairs outlet and intake grilles. Wooden cabinets are of black walnut with center and side overlays in modern design. Steel cabinets are of finest furniture steel finished in grain and color to harmonize with interior decoration.

Dealers Wanted—A splendid opportunity is offered to aggressive well-established dealers.

Write for the booklet "Controlled Humidity and Human Comfort," together with full details on the several Lewis Air Conditioners. The Lewis Corporation, 841 Second Ave., South, Minneapolis, Minn.

• • LEWIS
AUTOMATICALLY CONTROLLED
AIR CONDITIONERS



AT LAST!

The TRUTH about the "*Wiping* WALL-FLAME"

*M*ost important of the mechanical reasons why you should COMPLETE every installation with a Silent Automatic oil burner . . . and pocket two profits . . . is the fact that Silent Automatic alone has the "*Wiping* WALL-FLAME".

The "*Wiping* WALL-FLAME"

This slowly swirling flame constantly licks the entire wall of the fire-pot at grate level. The result is maximum over-all heating efficiency. Because of the quality of this slow flame, the furnace lasts longer. Moreover, this flame burns softly . . . it is never disquieting.

The "*Wiping* WALL-FLAME"

Because the "*Wiping* WALL-FLAME" enables the burner to work at peak efficiency, all the time it is running, heat is obtained just as fast as it is needed, even in the most responsive heating systems.

The "*Wiping* WALL-FLAME"

Home-owners are familiar with the principle and advantages of the "*Wiping* WALL-FLAME", because working with coal furnaces has taught them how maximum heating efficiency is obtained. Many other heating specialists are boosting their profits with "Silent" and its "*Wiping* WALL-FLAME". It's up to *you.*

SILENT AUTOMATIC CORPORATION
12001 East Jefferson Ave. Detroit, Mich.

For Warm Air, Steam and Hot Water Heating Systems—Old or New Homes

SILENT AUTOMATIC
THE NOISELESS OIL BURNER

Made by the World's Largest Producer of Domestic Oil Burners

C O U P O N

SILENT AUTOMATIC CORPORATION

Send me a copy of your booklet, "Silent Automatic Oil Heat for the Home" . . . immediately.

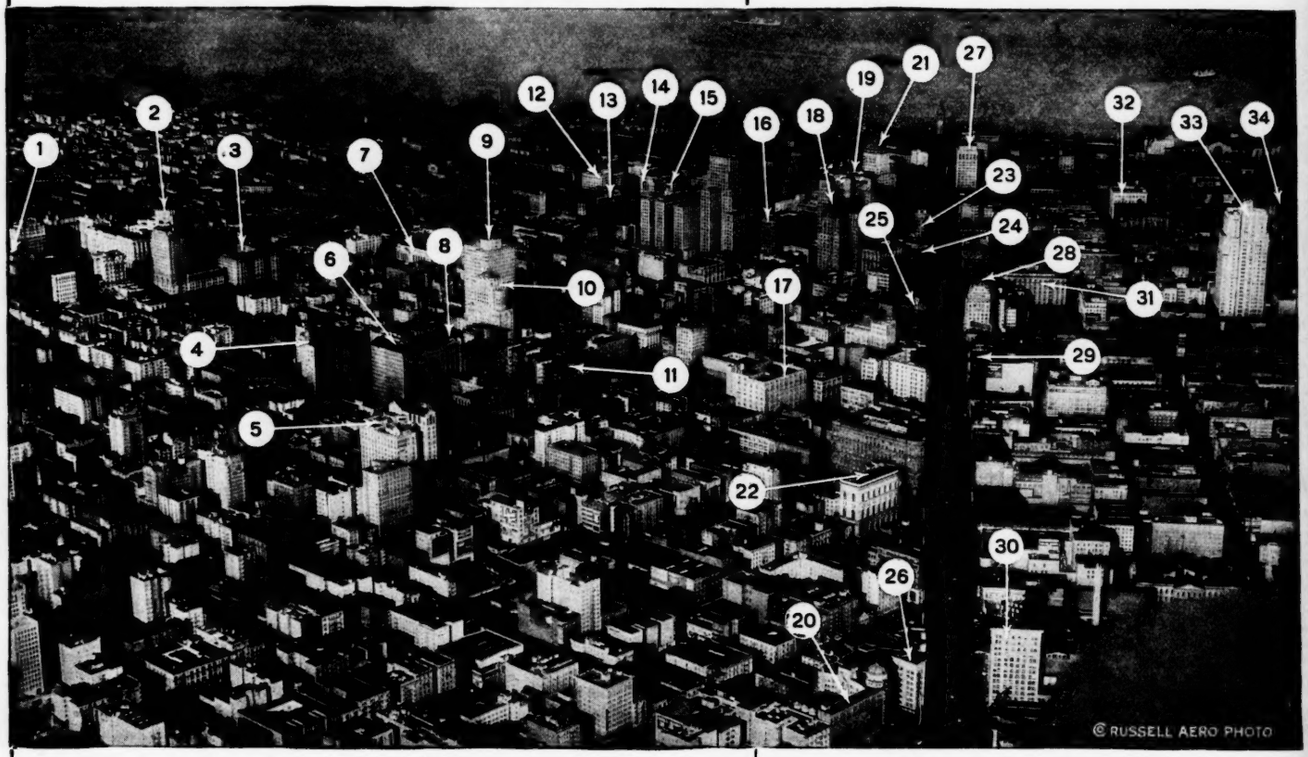
Name_____
Company_____
Address_____
City_____ State_____

(371)

These buildings in San Francisco's business section are served by Jennings Pumps:

1. Huntington Apartments
   1 Duplex Jennings Vacuum Heating Pump
2. Mark Hopkins Hotel
   1 Duplex Jennings Vacuum Heating Pump
3. Sanford Court Apartments
   1 Jennings Vacuum Heating Pump
4. Western Women's Club
   1 Duplex Jennings Vacuum Heating Pump
5. Clift Hotel
   1 Jennings Vacuum Heating Pump
18. Hunter Dulin Building
   2 Jennings Vacuum Heating Pumps
19. Standard Oil Building
   2 Jennings Vacuum Heating Pumps
20. Golden Gate Theatre
   1 Duplex Jennings Vacuum Heating Pump
21. Shell Oil Building
   2 Jennings House Service Pumps
22. Bank of Italy
   1 Jennings Vacuum Heating Pump

On guard at the Golden Gate



6. Medical-Dental Building
   1 Jennings Vacuum Heating Pump
7. Metropolitan Life Building
   1 Duplex Jennings Vacuum Heating Pump
   1 Jennings Vacuum Heating Pump
8. Elks Club
   1 Jennings Vacuum Heating Pump
9. 450 Sutter St. Bldg.
   1 Duplex Jennings Vacuum Heating Pump
10. Sir Francis Drake Hotel
   1 Jennings House Service Pump
11. St. Francis Hotel
   2 Duplex Jennings Vacuum Heating Pumps
12. 500 Sansome Street
   1 Jennings Vacuum Heating Pump
13. Financial Center Building
   1 Duplex Jennings Vacuum Heating Pump
14. Federal Reserve Bank Bldg.
   1 Jennings Vacuum Heating Pump
15. Commercial Union Building
   1 Jennings Vacuum Heating Pump
16. Alexander Building
   1 Jennings Vacuum Heating Pump
17. O'Connor & Moffat Store
   1 Duplex Jennings Vacuum Heating Pump
23. Crocker Building
   1 Jennings Vacuum Heating Pump
24. Wells Fargo Union Trust
   1 Duplex Jennings Vacuum Heating Pump
25. Crocker First National Bank
   1 Jennings Vacuum Heating Pump
26. Loew Warfield Theatre
   1 Duplex Jennings Vacuum Heating Pump
27. Pacific Gas & Electric Bldg.
   1 Jennings Vacuum Heating Pump
28. Claus Spreckles Building
   1 Jennings Vacuum Heating Pump
29. Bank of America
   1 Jennings Vacuum Heating Pump
30. Western State Life Ins. Bldg.
   1 Jennings Vacuum Heating Pump
31. Sharon Building
   2 Jennings Vacuum Heating Pumps
32. Walter N. Moore Building
   1 Jennings Vacuum Heating Pump
33. Pacific Tel. & Telegraph Bldg.
   2 Duplex Jennings Vacuum Heating Pumps
34. Butler Bros., Building
   1 Jennings Vacuum Heating Pump

IN more than thirty important buildings in San Francisco's business section, Jennings Vacuum Heating Pumps stand guard over return lines steam heating systems, assuring proper, efficient heating.

San Francisco's architects, engineers and building owners know that they can rely on these sturdy pumps to give years of service with little attention. The Nash Engineering Co., 81 Wilson Rd., So. Norwalk, Conn.

Jennings Pumps

The

H.B. SMITH

COMPANY

presents

A LINE OF BOILERS FOR OIL BURNING

1853 — 1931

With

SALES-MAKING FACTS

on

INSTALLATIONS
RATINGS
PERFORMANCE
EFFICIENCY
FUEL ECONOMY

A SILENT PARTNER SPEAKS . . .

As a pioneer Boiler manufacturer, The H. B. Smith Co. has been a silent partner in the rapid development of oil heating. Its contribution has been the manufacture of quality Boilers which, in addition to being highly efficient with other fuels, were especially suited for oil burning. During the past ten years The H. B. Smith Co. has been in constant touch with oil-burning developments. Its technical staff has been in frequent consultation with eminent engineers and oil burner experts seeking to improve, if possible, the oil-burning efficiency of the Mills-type Boiler.

But the verdict has always been this: The Mills-type Boiler is so well designed and proportioned that it will easily carry the load for which it is conservatively rated. **A change from solid fuel to oil simply results in greater efficiency** because the four major oil-burning requirements are absolutely inherent in the Mills-type Boiler. These requirements are:

1. Maximum Direct Fire Surface to insure quick steaming.

2. Vertical Water Tubes—designed for maximum heat absorption and proper circulation.

3. Intersectional Lateral Gas Travel which reaches every square inch of heating surface without wasteful escape through big flue ways.

4. Multiple Gas Passages which direct the heat downward, retarding it and holding it against the fire surface.

Now, because the Mills-type Boiler already possessed these special qualifications, the opportunity to increase its oil-burning efficiency has been exceedingly limited. In fact, if there were no other considerations except Boiler efficiency, further improvement would serve no practical purpose. But oil burner progress has developed new needs and requirements: A need for greater specialism in Boiler equipment. A need for refinement in design. And above all, a need for definite facts and recommendations which will insure maximum coordination between Boiler and Burner.

New Facts and Data

Until recently the oil burner could expect no more from the ordinary Boiler than moderately efficient operation when converted to oil firing. With rare exceptions burner installations were made in existing Boilers. In the absence of definite Boiler-Burner data, coordination between the two was dependent upon the hit-or-miss method of "trial and error."

The real need today is not for more Boiler information, as such, nor additional Burner data, but for facts based on a working partnership between the two.

Recognizing the vital importance of scientific facts and recommendations on this subject, The H. B. Smith Co. has utilized its fullest facilities in assembling new and authentic Boiler-Burner data. After extensive laboratory and field tests, it now makes definite recommendations regarding such important factors as the rate of oil consumption and the quality of combustion. All this information has been combined in a book which simplifies many of the problems connected with Boiler-Burner specifications and installations. "The Boiler-Burner Book" has been prepared with a view to providing architects, engineers, contractors and the oil burner trade with reliable information having a practical application to their problems.

NEW OIL BURNING FEATURES

After all, the major advantages to be gained from specialism in design and equipment are those which insure uniform all-round Boiler-Burner coordination. The Mills-type Boiler has always enjoyed outstanding preference for oil burning. Now new refinements make it even more adaptable to the modern oil burner.

New decorative features of color and finish—so important in modern merchandising—have been introduced. And while all the basic Mills principles of design and cast-iron construction have been retained, many new features have been added, including,

1. **Constructive Alterations**
2. **Automatic Draft Adjustment**
3. **Summer-Winter Domestic Hot Water Unit**
4. **Special Foundation Front**
5. **Combustion Observation Ports**
6. **Refinements in Appearance**

YOU WILL VALUE THIS FREE BOOK

By utilizing the detailed and specific information in the new Smith "Boiler-Burner Book," any good oil burner with the Smith Oil-Burning Boiler becomes the equivalent of an engineered BOILER-BURNER UNIT. In fact, close adherence to the specific recommendations given in this book will insure a minimum efficiency of not less than 75%. Under certain conditions efficiencies will be well over 80%.

You will indeed value this new Smith book. Among other subjects authoritatively treated, are

Boiler-Burner Ratings
Recommendations on Equivalent Installed Direct Radiation
Rate of Oil Consumption Per Hour
Relation of Boiler Efficiency to Fuel Economy
Draft Control
How to Select the Proper Size Boiler for Oil Burning
Summer-Winter Hot Water Supply Data
Analysis of Oil Combustion
Fuel Classifications

The titles listed above merely suggest the wealth of valuable information contained in "The Boiler-Burner Book," now on the press—a copy of which will be sent you on request.

LIMITED EDITION—*Don't Delay!*

The H. B. Smith Co. has gone to great expense in compiling the useful facts presented for the first time in this book. There is only a limited number available for free distribution. To make certain of reserving your copy, write today.

THE H. B. SMITH CO.

WESTFIELD, MASS.

NEW YORK . . 10 East 41st Street
BOSTON 640 Main St., Cambridge, Mass.
PHILADELPHIA . . 2209 Chestnut St.

USED IN FINE HOMES AND BUILDINGS
SINCE 1860

The H. B. Smith Co.
Dept. HV 1
Westfield, Mass.

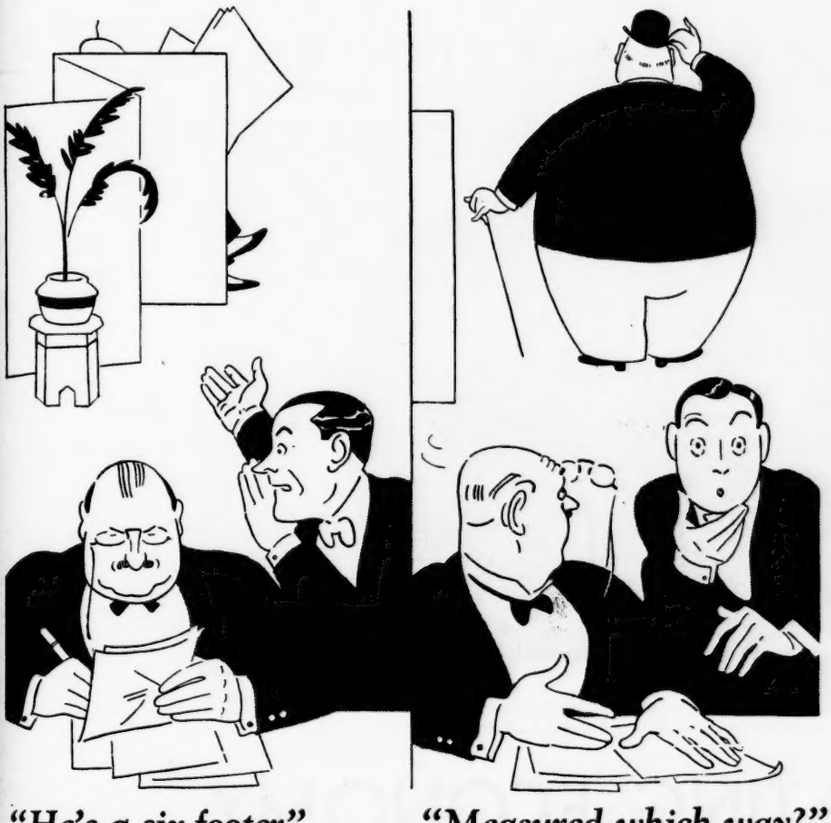
Please reserve and send me, free and without obligation, a copy of "The Boiler-Burner Book."

Name.....

Firm Name.....

Street.....

City.....State.....



"He's a six-footer" . . . . "Measured which way?"

Can figures be facts if they are wrongly arrived at?

In considering performance of heating systems, no analysis or comparison based on hasty acceptance of inaccurate measurements or of incomplete facts, can be safe, or useful.

Unless *all* the factors which may influence the result have been checked, to speak of, for example, "lbs. per sq. ft. per season" means just as little as to say "twice as long as a piece of string."

Altogether there are 45 of these variable factors,—each of which may affect the requirements and results for better or worse. To allow any one of them to be forgotten or disregarded may lead to faulty conclusions.

Engineers, architects and heating contractors will find the related subjects of heating steam consumption analysis, estimating and heating cost accounting, as presented by Warren Webster & Company, of vital interest.

A request for further details will bring a Webster steam heating specialist to discuss this vitally important subject.

A Heating System for Every Need and Every Purpose

Heating requirements vary so widely that no one type of heating system can be expected to provide the greatest return on the dollar invested in the heating equipment for all types and sizes of buildings. Realizing this, Warren Webster & Company have consistently developed an entire group of Webster Systems of steam heating to provide *a heating system for every need and every purpose.*

Webster MODERATOR System provides "Controlled - by - the-Weather" heating and makes possible new methods of operation and new standards of economy. Can be applied to any existing steam heating system of sufficient size.

IMPROVED Webster Vacuum System provides distribution balanced from the start—the supply of steam to each radiator is so equalized that all radiators get steam at the same time and in substantially the same proportion, regardless of distance from the boiler. May be supplemented by HYLO Vacuum Variator, permitting manual control by building operator. Applicable to new or existing installations.

IMPROVED Type "R" System for residences and larger buildings as well, combines advantages of steam heating with advantages of hot water, but without limitations. Meets fully the operating requirements of newer fuels, newer types of radiation and newer thermostatic controls. Also provides better-than-ever heating service with old radiation and old controls.

Full details of any or all of these systems will be furnished on request.

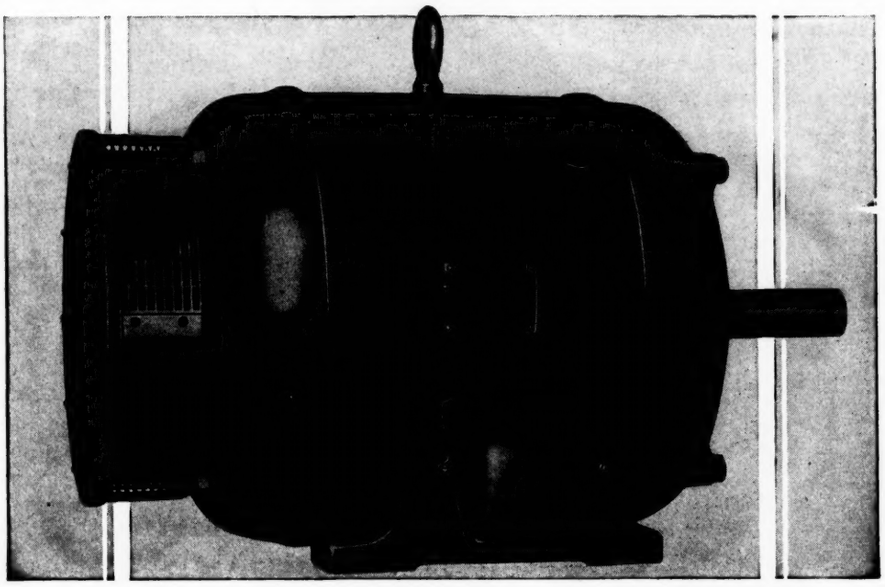
Warren Webster & Company, Camden, N.J.
Pioneers of the Vacuum System of Steam Heating
Branches in 60 Principal U. S. Cities
Darling Bros., Ltd., Montreal, Canada

-since 1888
Webster
Systems of Steam Heating

a155

This is one of a series of advertisements discussing the factors affecting heating steam consumption. The purpose of the series is to call attention to the methods of heating steam consumption analysis, estimate and heating cost accounting developed by Warren Webster & Company to provide a reliable basis for comparing heating system efficiency. Actual detailed facts and figures of steam consumption of a number of Webster Systems of Steam Heating, prepared in accordance with these methods, are available for your examination.

THEY KEEP A-RUNNING



10 Horse Power Century Type SC Multi-speed Constant Torque Squirrel Cage Induction 3 and 2 Phase Motor

OPERATING ECONOMY

Constant Horse Power ✓ Constant Torque ✓ Variable Torque

MULTI-SPEED MOTORS

The operating economy of Century Multi-speed Squirrel Cage Induction 3 and 2 Phase Motors results from their horse power rating being in direct ratio to the power demand at a given speed. . . .This makes them particularly desirable in all installations where lower operating cost is a factor or where adjustable speed requirements must be met—as in blowers, fans, stokers and similar apparatus.

They are built regularly for 2, 3 and 4 speeds with wide or narrow speed ranges, such as 1800/1200 or 1800/600 down to 900/450 r.p.m. (60 cycle). Special speed combinations are available.

Built in standard sizes from 1/10 to 125 horse power, in normal torque, high torque, normal or low starting current, in open, enclosed and totally enclosed fan cooled types.

CENTURY ELECTRIC COMPANY

1806 PINE STREET ✓ ✓ ✓ ST. LOUIS, MO.

40 U. S. and Canadian Stock Points and More Than 75 Outside Thereof

SINGLE PHASE, THREE PHASE, AND DIRECT CURRENT MOTORS

Century MOTORS

MOTOR GENERATOR SETS, ROTARY CONVERTORS, FANS AND VENTILATORS

808

FOR MORE THAN 26 YEARS AT ST. LOUIS

SERVICE THAT IS WITHIN 24 HOURS OF WHERE YOU ARE

Johnson Service Company maintains thirty branches on the North American continent: one in each of the twenty-five largest and geographically best situated cities in United States, and five likewise in Canada.

Each branch is Johnson *Service* Company; not an agency, dealer or contractor, but thoroughly *Johnson.*

Whatever the requirement, wherever the job is located, Johnson "Service", with direct attention by Johnson Company personnel, is available within twenty-four hours time.

In addition to this immediate service attention, each installation receives Johnson inspection annually.

This indicates the continued interest given by this company in the service of its system and apparatus.

JOHNSON SERVICE COMPANY 149 EAST MICHIGAN MILWAUKEE, WISCONSIN

Albany	Chicago	Des Moines	Los Angeles	Portland	Calgary, Alta.
Atlanta	Cincinnati	Detroit	Minneapolis	St. Louis	Montreal, Que.
Baltimore	Cleveland	Greensboro, N. C.	New York	Salt Lake City	Winnipeg, Man.
Boston	Dallas	Indianapolis	Philadelphia	San Francisco	Toronto, Ont.
Buffalo	Denver	Kansas City	Pittsburgh	Seattle	Vancouver, B. C.

ESTABLISHED 1885

Union Gas & Electric Company Building, Cincinnati, Ohio

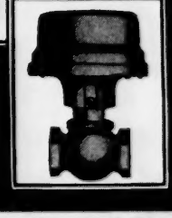
Architects:
Garber & Woodward . . . . . Cincinnati
John Russel Pope . . . . . New York City

Fosdick & Hilmer . . . . . Consulting Engineers

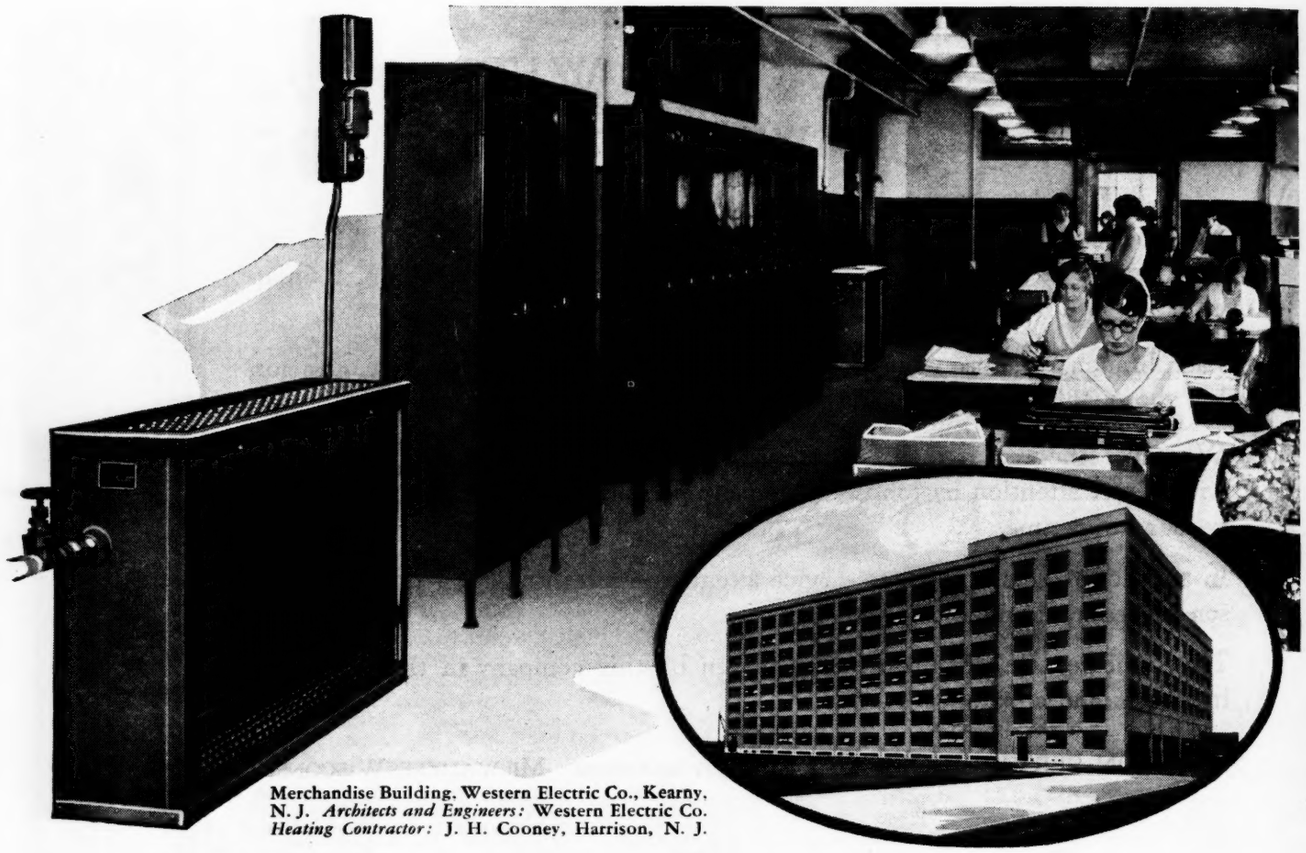
200 Johnson Dual Thermostats control 532 radiator valves in Union Gas & Electric Company Building: maintaining normal temperature during the day, automatically lowering the temperature for the night, and automatically returning the temperature to normal again each morning. In addition, this installation includes Johnson system fan control and Johnson cut-off fresh air and vent dampers on the building's ventilating system.

The All-Metal System. The All Perfect Graduated Control of Valves and Dampers.

The Dual Thermostat (Night & Day) Control: Fuel Saving 25 to 40%.



JOHNSON HEAT AND HUMIDITY CONTROL



Merchandise Building, Western Electric Co., Kearny, N. J. *Architects and Engineers:* Western Electric Co. *Heating Contractor:* J. H. Cooney, Harrison, N. J.

Heating Offices by Recirculation

. . . with Sturtevant Unit Heater-Ventilators

In the average unit heater-ventilator installation, heating is incidental to the primary ventilating function of the equipment. Consequently the advantages of using these units *solely* as recirculating heaters are often overlooked. These advantages are quick, uniform heating . . . close control of temperature . . . economy in operation.

A typical instance of efficient heating by recirculation is provided by the 21 Sturtevant Unit Heater-Ventilators in Western Electric's Merchandise Building at Kearny, N. J.

Since this equipment mechanically circulates the heated air, the offices are evenly heated throughout. There are no hot or cold spots. Desired room temperature is maintained by automatic control. Sturtevant Unit Heater-Ventilators heat more quickly than direct radiation . . . and give 6 to 10 times more heat! So the offices are quickly heated in the mornings . . . even Monday mornings! No need to keep heat up overnight or over the weekend. Sturtevant Unit Heater-Ventilators are adapted either to hot water heating . . . which is the system used in this building . . . or to steam. In the latter case, there is usually a worthwhile saving in steam, over direct radiation. The units are quiet and unobtrusive . . . both in operation and appearance.

Sturtevant Unit Heater-Ventilators are adapted to infinite installations . . . schools, stores, hotels, institutions and other places. Have you Catalog 361?

B. F. STURTEVANT COMPANY

Main Offices: HYDE PARK, BOSTON, MASSACHUSETTS; CHICAGO, ILLINOIS, 410 No. Michigan Avenue; SAN FRANCISCO, CALIFORNIA, 681 Market Street

Branch Offices in Principal Cities: Canadian Offices at: Toronto, Montreal and Galt. Canadian Rep.: Kipp Kelly, Ltd., Winnipeg. Agents in Principal Foreign Countries.

Sturtevant Unit Heater-Ventilator

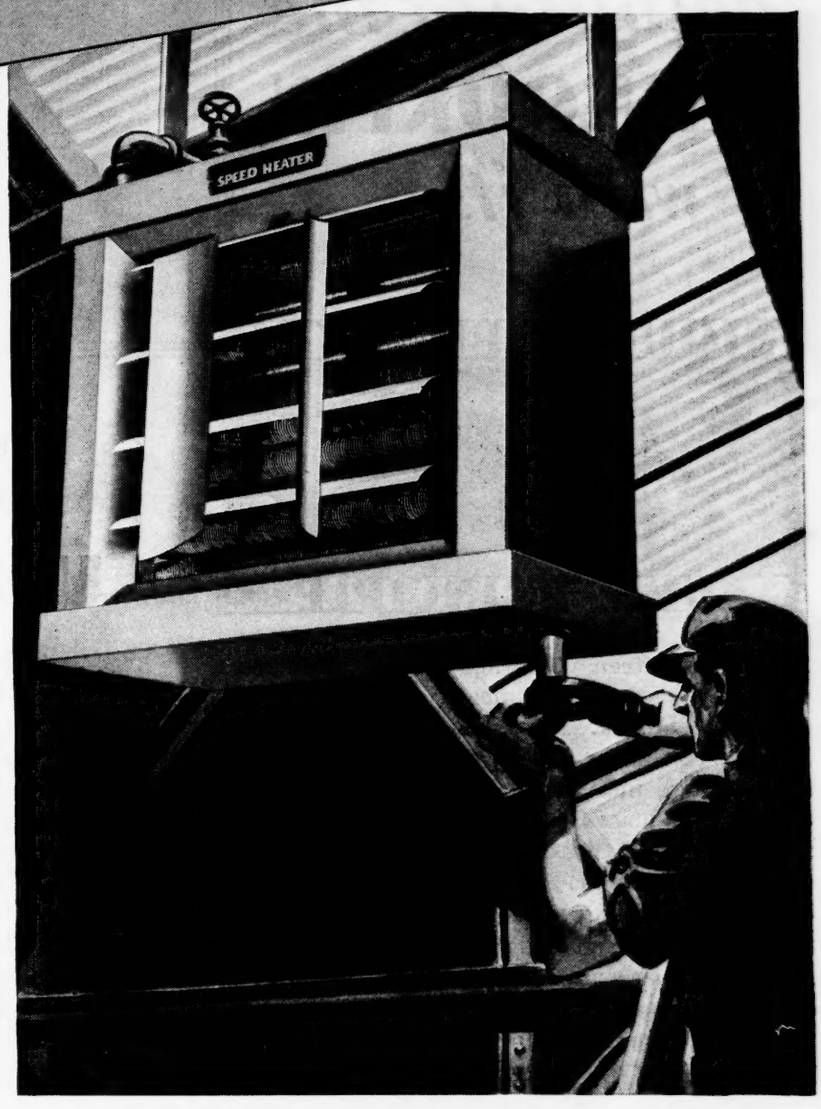
Reg. U. S. Pat. Off.

SUPPLIES OUTDOOR AIR ~ FILTERED CLEAN ~ AND TEMPERED

Matchless Value

OFFERED BY STURTEVANT

IN THE SPEED HEATER



A PRODUCT of the famous Sturtevant Research Laboratory, the Speed Heater has won the endorsement of all who have seen or used it.

"How in the world do you manage to turn out a heater like that at a price so moderate?" exclaimed an industrial executive at a recent heating exhibit.

The answers are... (1) Over 60 years of experience; (2) Sturtevant Engineering and Research Facilities; (3) Quantity Production!

If you install suspended type industrial heaters... we urge you to investigate the Speed Heater. We'll supply all the facts... you be the judge of Speed Heater efficiency... durability... value!

Speed Heaters for all standard voltages, A. C. and D. C., are carried in stock.

The Sturtevant Speed Heater is sold by

CRANE CO.

through dependable heating contractors everywhere

B. F. STURTEVANT CO.

Main Offices: HYDE PARK, BOSTON, MASS.—CHICAGO, ILL., 410 No. Michigan Ave.—SAN FRANCISCO, CAL., 681 Market St. *Branch Offices in Principal Cities.* Canadian Offices at: Toronto, Montreal and Galt. Canadian Representatives: Kipp Kelly, Ltd., Winnipeg. Agents in Principal Foreign Countries.

---COUPON---

B. F. STURTEVANT COMPANY,

(Mail to the nearest Main or Branch Office)

I would like a copy of The Speed Heater "COMPLETE DATA" Catalog.

☐ Check here... and one of our men will call.

*Company*_____

*Street*_____

H. V. 12-30

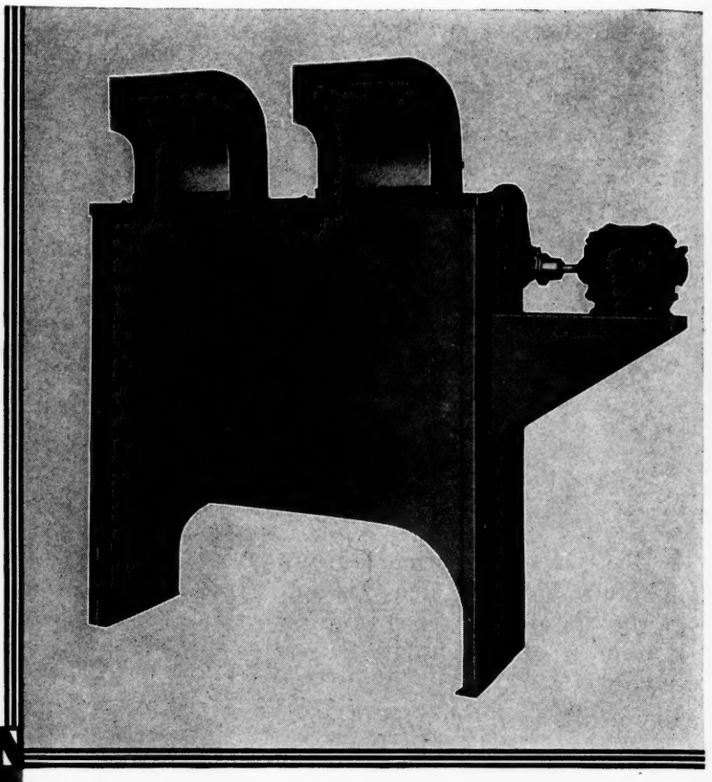
*City*_____

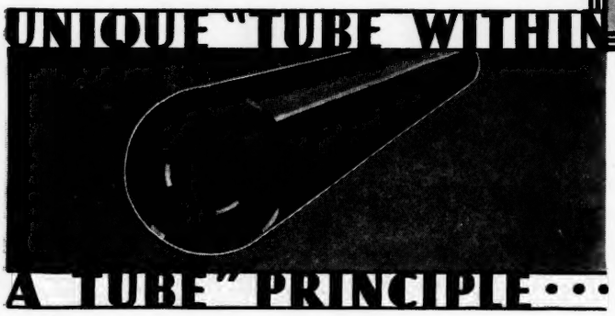
Sturtevant

(REG. U. S. PAT. OFF.)

SPEED HEATERS

An Efficient Heat Machine *because of the* CHINOOKFIN *with its...*





The BAYLEY PLEXIFIN UNIT HEATER

More than fifteen years ago Bayley perfected a unique type of indirect heater, under the trade name of Chinook. It possesses remarkable features: individual radiating tubes with individual feed through individual circulating pipes, no return bends, elbows, or rigid connections, flow of steam, air and water always in one direction, no air lock, steam hammer or short circuiting ... a heater which remains sound and tight under all steam pressures and constant thermal changes. These construction advantages were then augmented by making the radiating tubes of copper with extended fin surfaces ... an improved heater which we trade-named the Bayley Chinookfin.

BAYLEY BLOWER COMPANY

The Bayley Plexifin Unit Heater contains a Chinookfin heating element. The fan is of the multiblade type, the well known Bayley Plexiform. It furnishes a maximum volume of air against medium or low pressures, is quiet in operation, and permits the use of high speed motors. The standard bearing used is the Dodge Timken Roller of the pillow block type. The motor and fan assembly of the Plexifin is designed and built for continuous operation over long periods of time with little attention for lubrication and maintenance.

FEATURES:

COPPER RADIATING ELEMENT BAYLEY CHINOOKFIN

MULTIBLADE FAN BAYLEY PLEXIFORM

ROLLER BEARING DODGE TIMKEN

Uses high or low pressure steam.

All these features go to make up an exceedingly efficient heat machine. May we send you Bulletin No. 29-U giving complete information?

742 Greenbush St., Milwaukee, Wis.

Fans — Heaters — Air Washers — Unit Heaters — Heating, Ventilating, Drying, Air Conditioning, Humidity Control, Mechanical Draft.

Bayley

PLEXIFIN UNIT HEATERS

...and what can the poor engineer do?

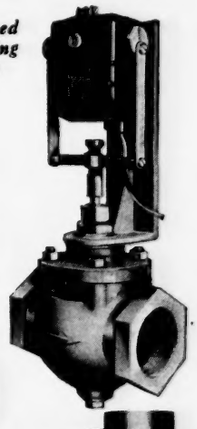
Precisely nothing—until a Minneapolis-Honeywell "tailor-made" system of heat control has been installed to regulate *each part* of the plant or building in accordance with *its* heating requirements.

For it's too much to expect one man, no matter how clever an engineer he may be, to regulate hand operated valves so that temperatures are right *and stay right.* And where a single system of control applies to the entire building the results are rarely satisfactory because the requirements in different departments vary so widely.

Minneapolis-Honeywell systems apply to direct radiation, indirect radiation and unit heaters, providing control individually or by groups or zones. They give you 72° in the offices, 65° in the shops, 50° in the warehouse, or any other temperatures your plant or building may require for maximum employee productivity and minimum fuel consumption.

Heat control engineering is as essential to the successful use of a building as architectural advice is for its original construction. The consultation service of Minneapolis-Honeywell heat control engineers is at your disposal without cost or obligation. Just mail in the coupon NOW for complete information.

Motorized regulating valve



Clock thermostat

Unifan control

MINNEAPOLIS-HONEYWELL REGULATOR CO.—2715 Fourth Ave. South, Minneapolis, Minn.
In Canada: Minneapolis-Honeywell Regulator Co., Ltd., Toronto.
Branch Offices: New York, Philadelphia, Boston, Providence, Detroit, Cleveland, Chicago, St. Louis, Milwaukee, San Francisco, Syracuse, Rochester, Indianapolis. *Distributors* in all principal cities

MINNEAPOLIS
INDUSTRIAL REGULATORS
HONEYWELL

MINNEAPOLIS-HONEYWELL REGULATOR COMPANY
2715 Fourth Ave. So., Minneapolis, Minn.

☐ Send me pamphlet on Unit Heater and Sectional Control Systems.
☐ Have representative call. I understand there is no obligation.

Name..... *Position*.....
Company.....
Address.....
City..... *State*.....

See our exhibit at the Ninth National Exposition of Power and Mechanical Engineering, Grand Central Palace, New York, December, 1st to 6th.

Armstrong Traps draining unit heater in large steel mill

The importance *of the* right trap *on* unit heaters

THE owner of a unit heater that is not equipped with the right trap gets just as unsatisfactory performance from it as he does from an automobile engine fitted with a badly adjusted carburetor.

Many heating engineers are therefore specifying Armstrong inverted bucket steam traps for unit heater installations. These traps keep the heater up to full efficiency at all times because of these Armstrong features:

—*large capacity.* In pounds of water discharged per hour (the only scientific way to measure steam trap capacity) Armstrongs have greater capacity than most traps of much larger size.

—*small size.* This is especially important with unit heaters suspended in mid-air. Armstrongs can be supported by connecting pipes.

—*no airbinding;* no clogging from scum or sediment (Armstrongs are self-scrubbing); no steam leakage (they are always water-sealed);no wire-drawing(chrome steel valves).

All these features make the Armstrong Trap practically foolproof. They operate years without attention. Repair expense is negligible. We will gladly send data on heating systems and catalogs at your request.

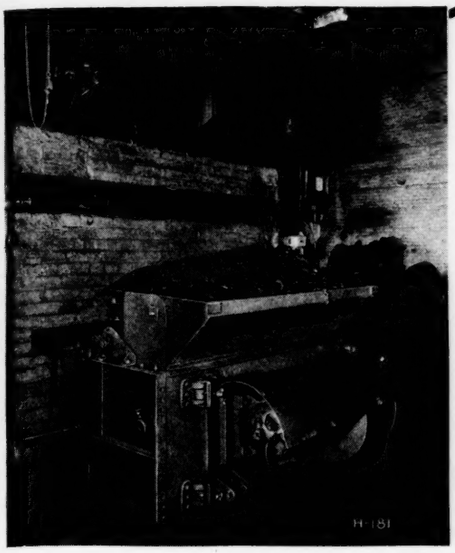
ARMSTRONG "INVERTED BUCKET" STEAM TRAP

H & V 12 Gray

ARMSTRONG MACHINE WORKS

THREE RIVERS, MICHIGAN

District Representatives in 42 Cities



The Most *F-l-e-x-i-b-l-e* Stoker Available!

YOU can use the Whiting Stoker on any boiler 25 to 250 horsepower—providing heating steam, power steam, or hot water, fired under any conditions—and increase its efficiency.

Fits Any Boiler—The Whiting Stoker is made in a great number of sizes and two models, Standard and Lowset. It is easily installed under any boiler and with a minimum of alterations on the boiler.

Burns Any Kind of Coal Screenings—The cheapest screenings burn very well in the Whiting Stoker. High ash coals, such as Iowa coal, burn equally well.

Adjustable to Extremes of Heating—Movement of the grates, which pushes the fuel across the firebed, and the feed-gate are adjustable. With these two adjustments on the amount of coal, extreme variations are possible. The hot-by-day, low-at-night fire of a laundry or the steady, warm fire of a hospital are possible with the same stoker.

Simple and Easily Operated—No special labor is needed just to "keep the hopper full." Apartment janitor, greenhouse laborer, laundry help—anyone can operate this stoker.

For:

Schools

A school in Iowa saves $2.50 per ton of coal because, with Whiting Stokers, inexpensive local coal screenings are used.

Laundries

Two Pittsburgh laundries each saved 70 tons of coal a month this last summer.

Apartment Houses

Many apartment managers report the faultless heating and steady hot water supply with boilers fired with Whiting Stokers.

Y. M. C. A.'s

The South Bend "Y" saves over $1,500 in the six cold months of each year.

Industrial Plants

A company making steel machinery saves $3,600 a year with Whiting Stokers.

Greenhouses, Hotels, Office Buildings, etc.

Write and find out more about this most flexible stoker!

In Any Installation—the Whiting Stoker Will Make Big Savings!

Burning less coal and the cheapest kinds of coal; getting better, steadier heat; being easily installed; reducing costs of labor, ash-disposal, maintenance, and operation—all result in economies for which this stoker is well known.

Write for booklet that describes this stoker and includes the letters of users who report savings as high as $3,600 on a year's coal costs alone!

JOSEPH HARRINGTON CO., Subsidiary

WHITING CORPORATION

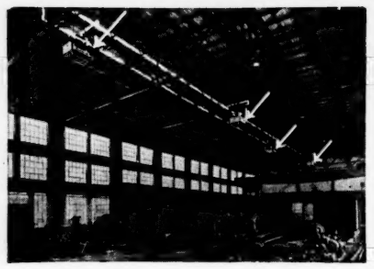
15695 Lathrop Ave., Harvey (Chicago Suburb) Illinois

Patented Joseph Harrington, Engineer

WHITING STOKER

Directly Overhead

either high above the floor



or with ordinary low ceilings

They Spread Heat In All Directions

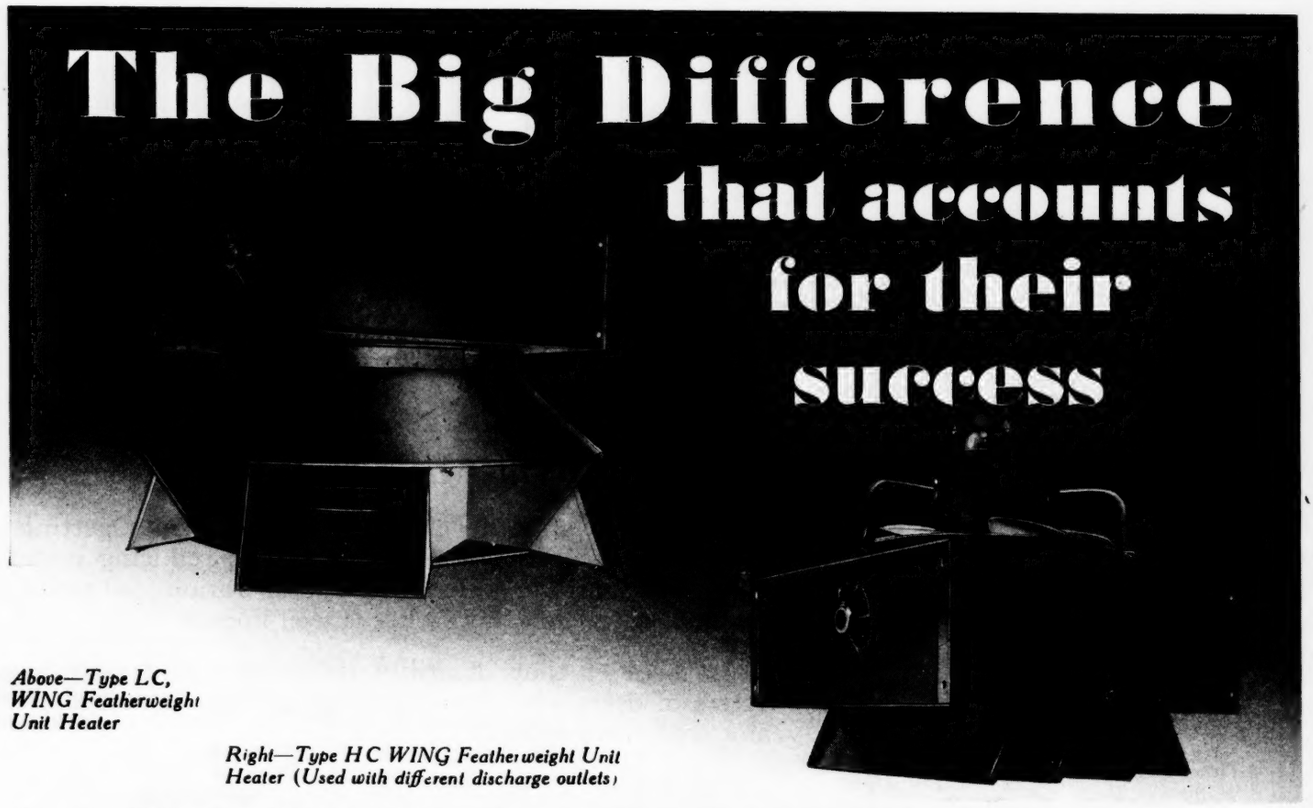
BECAUSE, unlike most heaters, they discharge vertically downward, Wing Featherweight Unit Heaters can be installed directly over the floor space that they heat, distributing warm air currents down in all directions. *This enables them to heat buildings with fewer heaters.*

They are placed high up under the central part of the roof to maintain a downward movement of all the warm air in the building.

Wing Featherweight Unit Heaters are unusually light, strong and very durable. They are made in ten sizes, two types and have a selection of eight discharge outlets. It is very easy to adapt them to the needs of particular buildings.

Write for catalog showing actual installations.

The Big Difference that accounts for their success



Above—Type LC, WING Featherweight Unit Heater

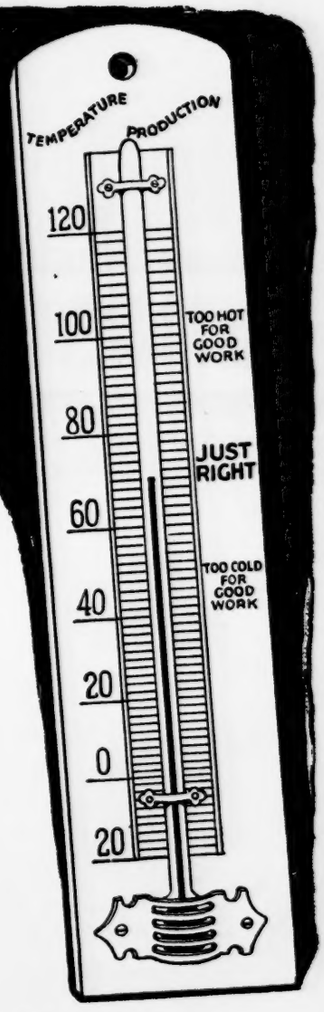
Right—Type HC WING Featherweight Unit Heater (Used with different discharge outlets)

L. J. WING MFG. CO., Dept. 12, 158 W. 14th St., New York, N. Y.

Manufacturers of Wing-Scruplex Safety Ventilating Fans and Exhausters, Wing Featherweight Unit Heaters, Wing-Scruplex Fog Eliminators, Motor and Turbine Blowers.

WING FEATHERWEIGHT UNIT HEATERS

Your Thermometer does more than just register Temperature!



Your thermometer helps you determine what degree of production efficiency is possible in your plant at any given time.

Your men and your machines can produce with *maximum* efficiency only when the mercury stands at the "just right" level.

Skinner Brothers' Engineers, with years of training and experience in providing "just right" temperature and air conditions in all types of industrial buildings, under all kinds of conditions, will gladly talk with you concerning the correct heating and ventilating of your plant, or the application of unit heating to your process work, without obligating you in any way. . . . Telephone the Skinner Brothers' Engineer in your city today, or write direct to Skinner Brothers in St. Louis, outlining your problem.

The fans in Skinner Brothers Unit Heaters can be used for cooling in the summer.

Skinner Bros. Unit Heaters

SKINNER BROS. MANUFACTURING COMPANY, Inc.
1402 S. Vandeventer Avenue, St. Louis, Mo.
Branches in All Principal Cities ***"The Originators of Unit Heating"***

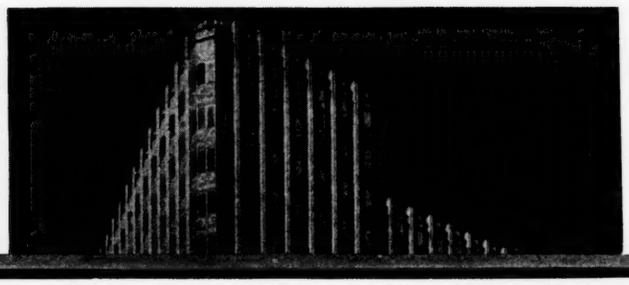
A UNIT HEATER FOR EVERY INDUSTRIAL HEATING AND VENTILATING REQUIREMENT

Skinner Bros. "Baetz Patent" Air Heater

Skinner Bros. Patented Direct-Fired Air Heater

Skinner Bros. Patented "Lightweight" Air Heater

Skinner Bros. Type "U" Air Heater



ILLINOIS HEATING SYSTEMS

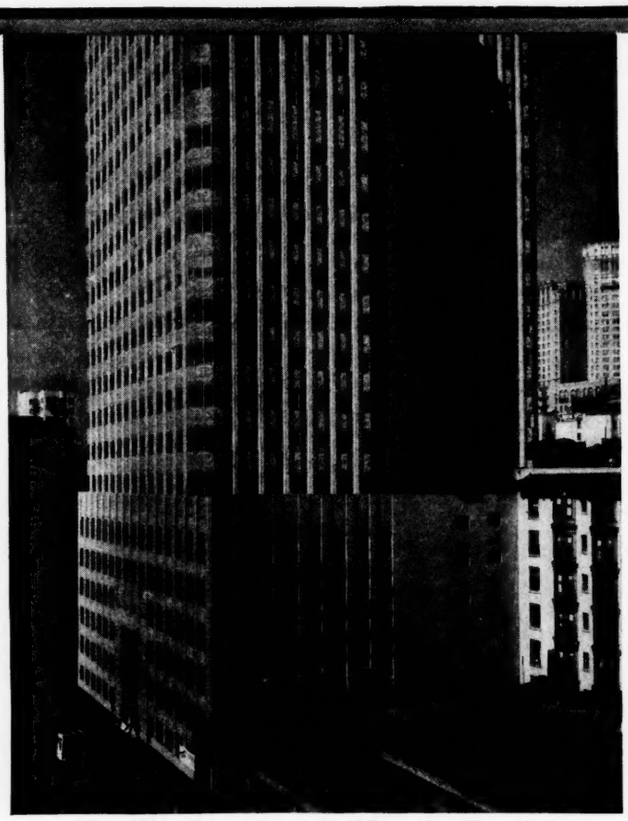
J. R. Miller & T. L. Pflueger
Architects

Lindgren & Swinerton, Inc.
General Contractors

Leland & Haley
Consulting Engineers

Frederick W. Snook Company
Heating Contractor

All of San Francisco



Four-Fifty Sutter Street Building, *San Francisco*

THIS stately, dignified, sculptural mass, with ornament in low relief and held within the silhouette, is a happy and complete expression that typifies precisely the spirit of our present day living and thinking. Four-Fifty Sutter Street Building is modern in every sense of the word—not only in appearance but in equipment—and part of that equipment is an ILLINOIS Heating System.

Write for Bulletins 22 and 61

ILLINOIS ENGINEERING COMPANY

ROBT. L. GIFFORD. PRES. INCORPORATED 1900

BRANCHES AND REPRESENTATIVES IN 40 CITIES

CHICAGO

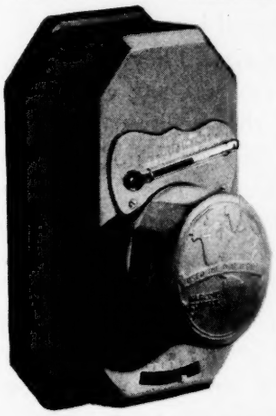
ANOTHER YEAR is closing and we are grateful for the measure of consideration extended to us. It gives us much pleasure to anticipate the opportunity to be of greater service to the Trade during the coming New Year.

MERCOID THERMOSTAT

No. 855 . . . FOR UNIT HEATERS

Mercoid Thermostats are extensively used for unit heaters, because they economize on fuel and current consumption.

The Mercoid Thermostat contains the Figure 9-51 Mercoid Tipless Switch, which is a development of The Mercoid Corporation. There is no open arcing or corrosion of contacts wherever Mercoid Controls are used.



The Mercoid Thermostat is unique in design. The thermal element is exposed directly to the room atmosphere and responds quickly to any changes in air temperature. It is neat in appearance and dependable in performance.

The Mercoid Thermostat requires no relay and will operate directly where the normal working load does not exceed 10 amperes at 110 volts or 5 amperes at 220 volts A.C. or D.C.

Standard range for unit heaters:

38 to 60 degrees F. Approximate normal operating differential 1½ degree.

At a small additional cost, a locking device may be applied to prevent tampering. Further information upon request.

THE MERCOID CORPORATION

4201 BELMONT AVE. Chicago, Illinois, U. S. A.

25 CHURCH STREET
New York, N. Y.

1129 FOLSOM STREET
San Francisco, Calif.

Cable Address "Mercoid" Chicago

Mercoids are shipped to every part of the world where automatic electrical equipment is used. Mercoid patents are held by The Mercoid Corporation, an independent organization, which is not controlled by any other company.

MERCOID CONTROLS

SEE HOW Sales and Profits Increase

When.....

you have a small rotary... a spark ignition burner... a heavy fuel oil burner ... an automatic burner for big commercial jobs ... a burner for big industrial heat and power plants ... all backed by the same company!

Just analyze one month's sales that ran over a million dollars retail. Here are the figures:

47% of all the burners sold were of the type utilizing the heavier grades of fuel oil. This included installations in homes, apartments and other large buildings.

33% were of the rotary type using lighter fuel oil. The remaining 20% was of the gun type with straight spark ignition.

With only one type of burner, not more than 47% of these jobs could have been sold. To reach the million dollar volume, various types of burners were needed, all specifically adapted to various types and sizes of boilers.

The dealer with only one type of equipment must choose between a restricted sales volume and the danger of installing the wrong type of burner in certain boilers.

Out of our 27 years experience in oil heating exclusively, serving more than 70,000 users from coast to coast and distributing our own oil in our trucks, has come a complete line of equipment utilizing every recognized principle of oil heating.

Our dealers alone have the opportunity to sell one line of oil burners to heat small homes and skyscrapers, to supply power and electricity, to heat water in laundries, to bake bread in bakeries, to grow orchids in greenhouses, to melt lead in newspaper plants and a hundred other uses. Naturally retail salesmen thrive on this diet.

Our dealers are IN the oil burner business. The WHOLE market is theirs. They are selling our burners from $295 up to $60,000, yet their parts inventory, because of the facilities of our many branches and supply depots, is no greater than that of the ordinary dealer. They also have the engineering counsel of our special field staff on all jobs requiring a high degree of technical skill.

A new program of expansion provides an opportunity for several high grade, skilled operators in various sections of the country, who recognize these advantages of representing a complete line.

PETROLEUM HEAT & POWER COMPANY

General Sales Offices and Factories: Stamford, Conn.

PETRO

New York
Chicago
San Francisco
Los Angeles

Oakland
Boston
Baltimore

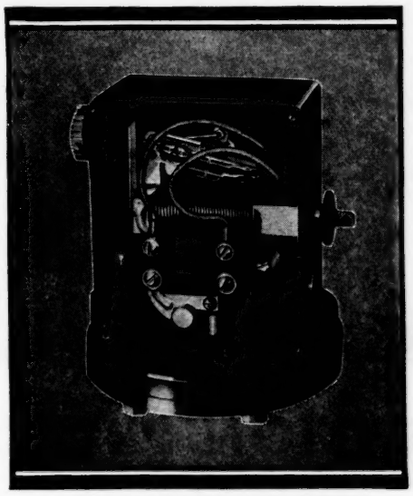
Philadelphia
Washington
Providence

Newark
Seattle
Tacoma
Portland

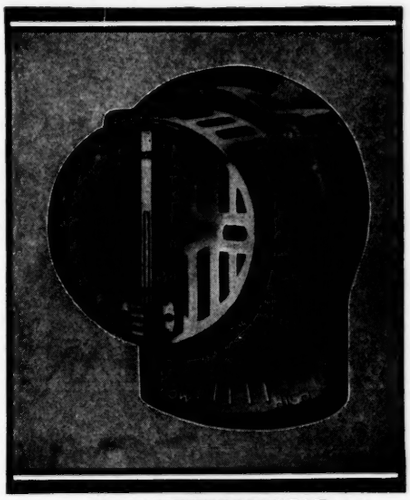
NOKOL

ADDITIONAL PROFITS

No. 56 AQUASWITCH
(Mercury Switch Equipped)



No. 33 PRESSURESWITCH
(Mercury Switch Equipped)



No. 135 THERMOSTAT
(Mercury Switch Equipped)

REPLACEMENT business is profitable business. Progressive oil burner dealers are actively creating replacement business with TIME-O-STAT Automatic Controls. These control sales will keep their sales and service organization together, profitably through the winter months when burner sales are fewer.

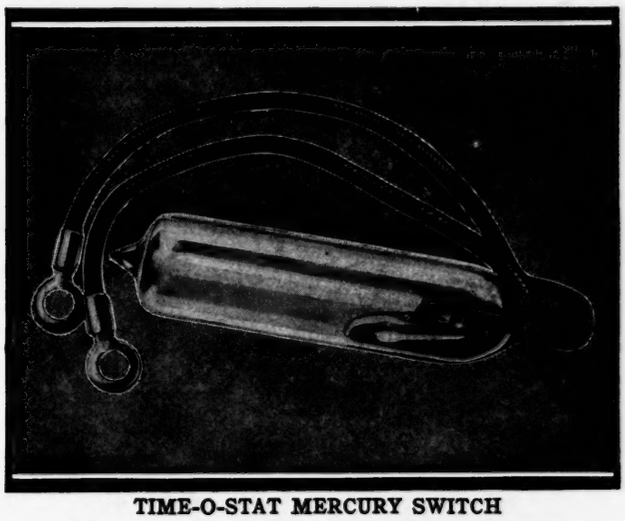
A check-up right in your own community will reveal many installations three or more years old, that need complete replacement of controls. Others need additional controls to modernize and protect the installation.

Modern in design, construction and operation, TIME-O-STAT Controls are Mercury Switch equipped. Because of these Mercury Switches TIME-O-STAT Controls assure long life and trouble-free operation.

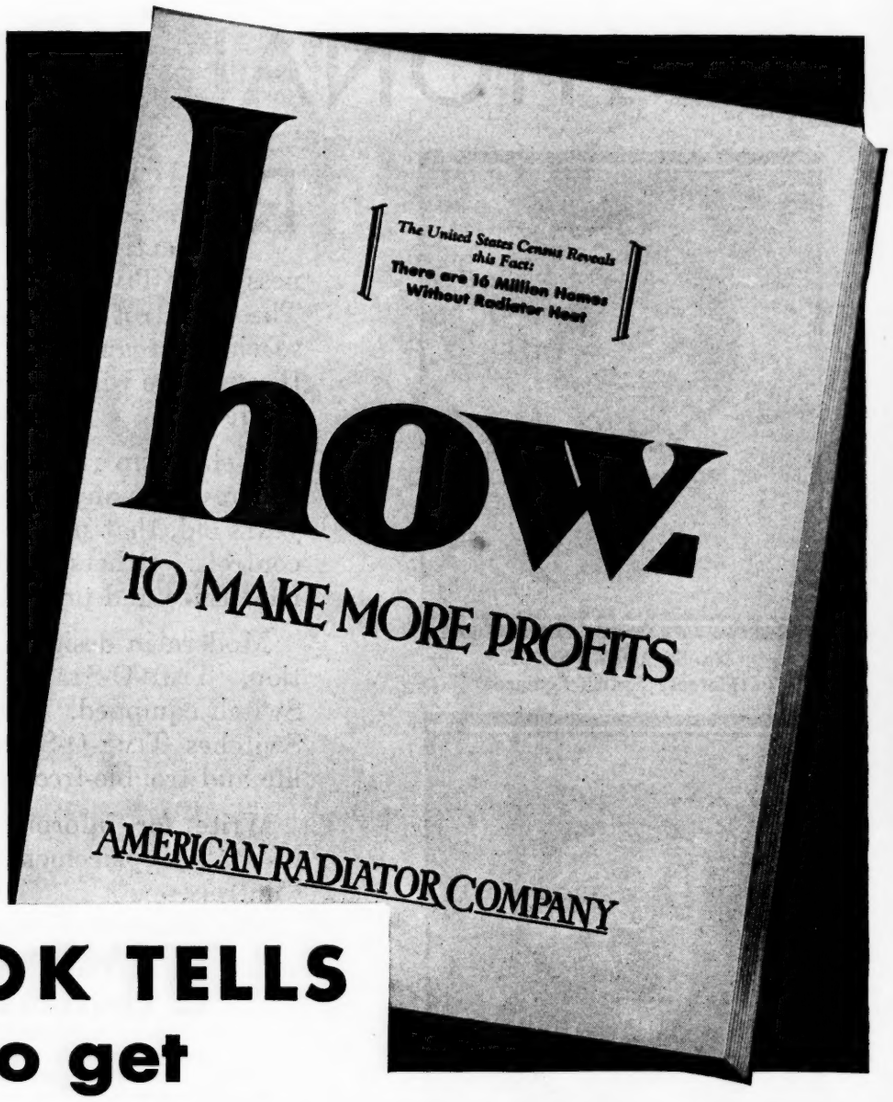
Write for information on how to make profitable replacement sales with TIME-O-STAT Controls.

TIME-O-STAT
CONTROLS COMPANY
ELKHART, INDIANA
BRANCH OFFICES: NEW YORK, BOSTON, CHICAGO
EXPORT DEPARTMENT: NEW YORK
EXCLUSIVE DISTRIBUTORS IN ALL PRINCIPAL CITIES OF THE UNITED STATES
CANADIAN DISTRIBUTORS — TORONTO AND MONTREAL

Manufacturers of Automatic Controls for Oil Burners, Gas Burners, Coal Burners, Electrical Refrigerators, Furnace Fans, Mechanical Stokers, Industrial Ovens, Ice Machines, Unit Heaters . . . also of Sign Flashers, Mercury Switches, Electric Heaters.



TIME-O-STAT MERCURY SWITCH
Clean, positive switching action. No open contacts to corrode, catch dirt, burn or wear out.


The United States Census Reveals this Fact:
There are 16 Million Homes Without Radiator Heat
how
TO MAKE MORE PROFITS
AMERICAN RADIATOR COMPANY

THIS BOOK TELLS how to get YOUR SHARE OF MODERNIZATION PROFITS

Every Thursday night we are broadcasting the story of modernization to every part of the country—telling the public how easy it is to have modern radiator warmth for just a little down and a little each month.

There are 16 million homes without radiator heat. Right in your neighborhood there are many owners who have been planning to modernize their homes by installing it.

The 42-page book shown above tells how to get your share of this profitable business. We will be glad to send you a copy and tell you how to become a qualified user of our Time Payment Plan if you will write us.

AMERICAN RADIATOR COMPANY

DIVISION OF

AMERICAN RADIATOR & STANDARD SANITARY CORPORATION

40 WEST 40th STREET, NEW YORK

THE MARCH OF PROGRESS *demands* MODERNIZATION of HOUSE HEATING METHODS

What is more essential to health, comfort and happiness than a well heated home? Yet, it is only recently that heating methods have joined the "march of progress."

"Thrush System" offers you an opportunity to profit through this movement. The superior features of "Thrush System" are readily apparent to the home owner and selling resistance is reduced to a minimum.

MAIL THIS COUPON TODAY!

H. A. THRUSH & CO., Peru, Ind.

Gentlemen:

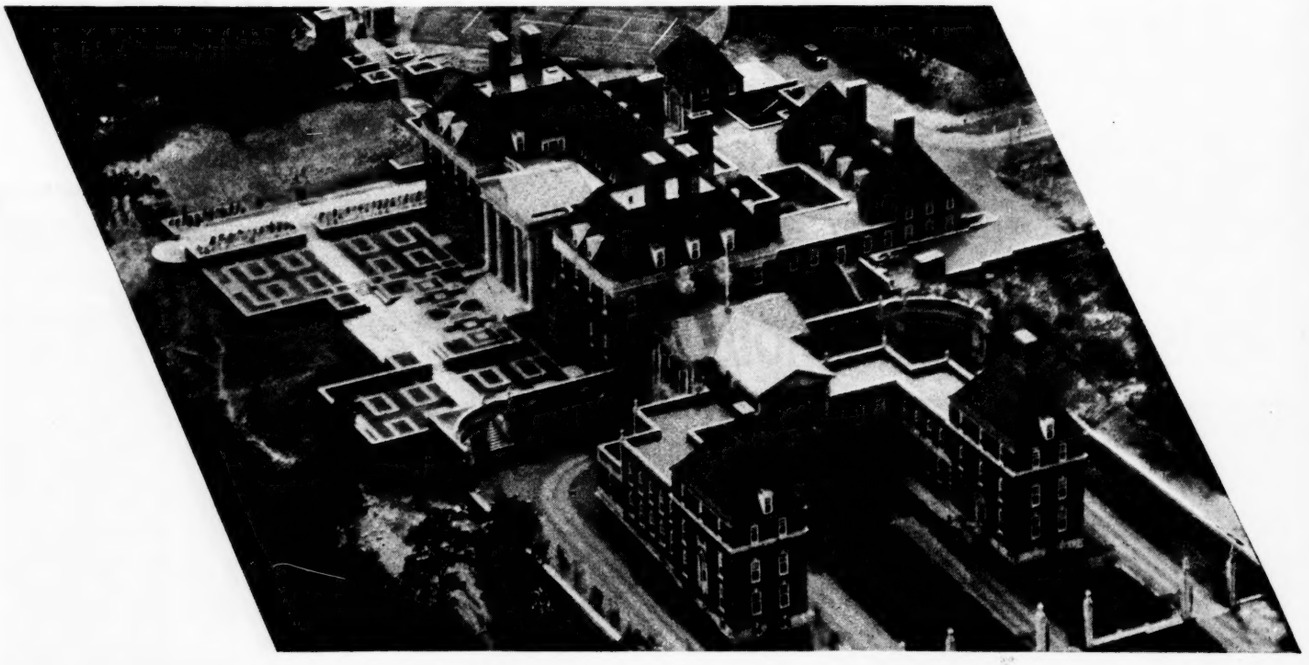
How can I start a Heat Modernization program in my territory, and how can you help?

Name_____

Firm_____

Address_____

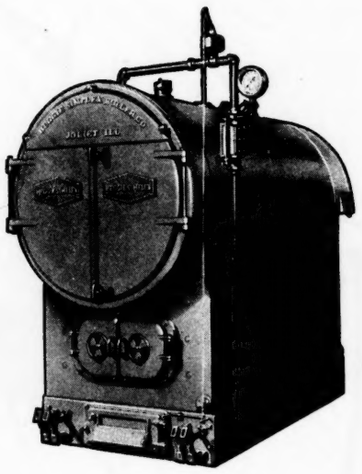
H. A. THRUSH & COMPANY
PERU INDIANA



CHOSEN for the New British Embassy in Washington, D. C.

AMONG the prominent Embassy buildings in Washington which are being heated this winter by Heggie-Simplex Steel Boilers is the new palatial residence of Sir Ronald Lindsay, British Ambassador to the United States.

In view of the fact that most of the equipment and materials for this building were imported from England, the selection of Heggie-Simplex Boilers is a noteworthy tribute both to the efficiency of these units and the excellence of American craftsmanship.



The extra large fire-box of Heggie-Simplex Boilers gives fuel more room to burn. There is more heating surface in direct contact with the fire to absorb its radiant heat. Unrestricted water circulation and "rear-front-rear" tubular flues further assure complete utilization of heat units. Electric-welded steel construction prevents cracks and leaks, and minimizes maintenance and insurance charges. For details address Heggie-Simplex Boiler Co., Joliet, Illinois. Representatives in all principal cities.

HEGGIE-SIMPLEX

STEEL HEATING BOILERS

HEATING AND VENTILATING

REG. U. S. PAT. OFF.

MEMBER AUDIT BUREAU OF CIRCULATIONS

formerly

The Heating and Ventilating Magazine

CONTENTS

INDUSTRIAL BUILDING REFERENCE NUMBER

DECEMBER 1930

Design, Operating Characteristics and Selection of Unit Heaters ..... *J. H. Smith* 62

Designing an Industrial Service Boiler Plant ..... *R. W. Noland* 71

Air Conditioning for Windowless Industrial Buildings ..... *J. W. McA. Kreuttner* 77

Duct Design for Fan-Steam Systems ..... *Walter F. Heibel* 82

State Laws Relating to Heating and Ventilating Industrial Buildings 87

The Fuel Question

Coal ..... *Lester C. Bosler* 95

Gas ..... *C. George Segeler* 98

Oil ..... *Clifton L. Butler* 104

Selection of Air Filters ..... *Howard C. Murphy* 108

Industrial Airation ..... *W. C. Randall* 111

Fuel Selection and Automatic Stoking in Heating Plants ..... *Joseph Harrington* 114

Firing Steam Boilers with Oil ..... *Harry E. Gilbert* 115

Weather for October, 1930 116

Monthly Degree Day Data for October, 1930 120

Heating and Ventilating Statistical Service 124

Engineers' Specification Index, Page 152

Advertisers' Index, Page 158

VOL. 27 **No. 12**

Our New Editor

HEATING AND VENTILATING has a new editor. With this issue, the destiny of the magazine passes into the hands of Charles H. B. Hotchkiss, formerly professor of heating and ventilation at Purdue University.

In welcoming Professor Hotchkiss to the editorial chair, I can think of no finer wish than that he, too, may experience the thrill of the firing-line, the glow of friendly support, and the pride of achievement, which add so much to the fascination of editorial work.

HEATING AND VENTILATING, of course, will have my continued interest, and its new editor, my heartiest support and good wishes.

A. S. Armagnac

Reference Numbers

Each a treatise on a particular class of building

April 1931 Issue — Public Buildings and Institutions

Later Reference Numbers will include—

Transportation Buildings — Department & Other Stores — School Buildings

Theatres — Churches — Hospitals — Hotel and Apartment Buildings — Office Buildings — District Heating

HEATING AND VENTILATING, formerly The Heating and Ventilating Magazine, is published monthly by Building Division, National Trade Journals, Inc., 521 Fifth Avenue, New York, N. Y., publishers of The Architectural Forum, Good Furniture and Decoration, and National Builders Catalog.

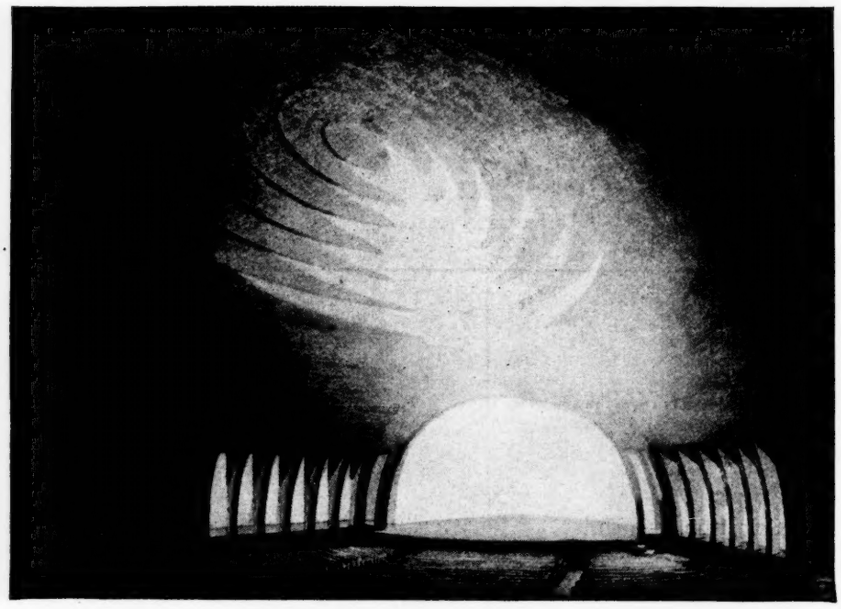
Wheeler Sammons, Chairman of Board; H. J. Bligh, President and General Manager; E. J. Rosencrans, Secretary and Treasurer; H. J. Redfield, Comptroller.

Editorial and Publication Office, 521 Fifth Avenue, New York, N. Y. Branch offices: Chicago, 75 East Wacker Drive, Telephone Randolph 0743; Pacific Coast and South, Blanchard-Nichols-Coleman, Los Angeles, San Francisco, Seattle, Atlanta.

C. H. B. Hotchkiss, Editor; Clifford Strock, Associate Editor; A. S. Armagnac, Advisory Editor; Cliff W. Presdee, General Manager; John F. Hyde, Eastern Representative; George G. Turner, Western Manager; European Representative, W. G. Hollinworth, Somerleyton Road, Oulton, Lowestoft, England.

Subscription Rates—Subscription price $2 per year in United States and Mexico; $2.50 in Canada; all other countries, $3.00. Single copies, 30 cents. Reference Numbers, $1.

Copyright, 1930, by National Trade Journals, Inc.



New School for Social Research, New York. Equipped with 146 Sarco Radiator Traps and 12 Sarco Float and Thermostatic Steam Traps.

Architect—Joseph Urban
Engineers—Syska & Hennessy
Heating Contractors—Johnson & Morris

10,000 Students will Enjoy the Comfort Assured by Sarco Heating System

ILLUSTRATION shows the auditorium of the New School for Social Research in New York, which seats 600 persons.

Over 10,000 students registered for courses in their old structure. Several times that number will undoubtedly attend their greatly enlarged and modern school and enjoy the comfort assured by the Sarco Heating System.

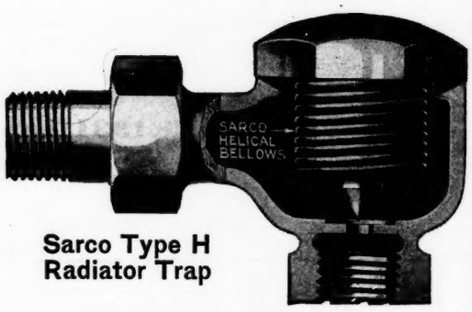
Sarco Radiator Traps can be depended upon to perform satisfactorily and give long, uninterrupted service.

The entire body is of non-corrosive cast bronze, heavily nickeled—no cast iron with a separate seat which may leak.

The bellows are made from seamless phosphor bronze tubing and have from 9 to 14 helical corrugations, depending on the size—not single or double disc diaphragms soldered together and quickly fatigued.

Valve heads are self-aligning and conical, and always center perfectly in the seat.

They cannot air bind or freeze.
Write for Catalog P-80.



Sarco Type H
Radiator Trap

SARCO
RADIATOR
TRAPS
BUILT TO
A QUALITY
STANDARD

SARCO COMPANY, Inc.
183 MADISON AVE. NEW YORK, N. Y.
Branches in all Principal Cities

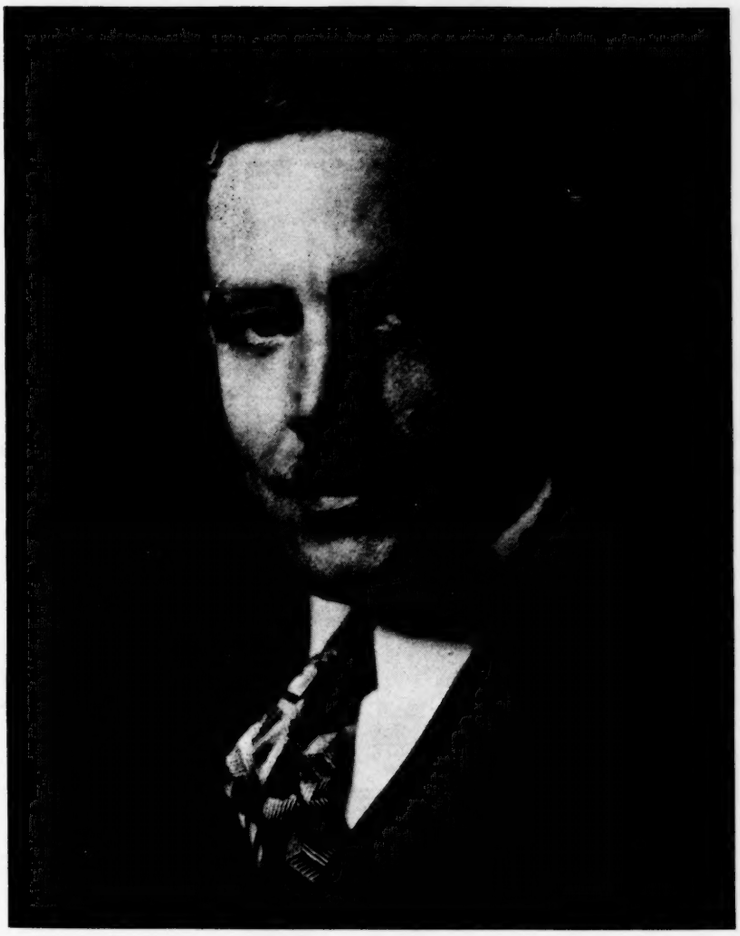


PHOTO BY BLANK & STOLLER, INC.

C. H. B.
HOTCHKISS
Editor

Consistent with its twenty-six year old policy of keeping pace with the development of the industry, Heating and Ventilating announces its augmented editorial staff.

C. H. B. HOTCHKISS, Editor

B.S. and M.E., Pennsylvania State College. . . . Associated with commercial practice. . . . Instructional and Investigational staffs at Pennsylvania State College and Purdue University. . . . Editor of Handbook of District Heating. . . . Contributor to trade and technical press. . . . Member A.S.H.V.E. . . . Associate Member A.S.M.E. . . . Tau Beta Pi. . . . Phi Kappa Phi.

CLIFFORD STROCK, Associate Editor

Machinist apprentice and draftsman, Pennsylvania Railroad, 1918-22. . . . Purdue University, B.S.M.E., 1926. . . . International Heater Company, 1926-28. . . . Heating and Ventilating, Assistant and Associate Editor since 1928. . . . Associate Member A.S.H.V.E. . . . Junior Member A.S.M.E. . . . Tau Beta Pi. . . . Pi Tau Sigma.

A. S. ARMAGNAC, Advisory Editor

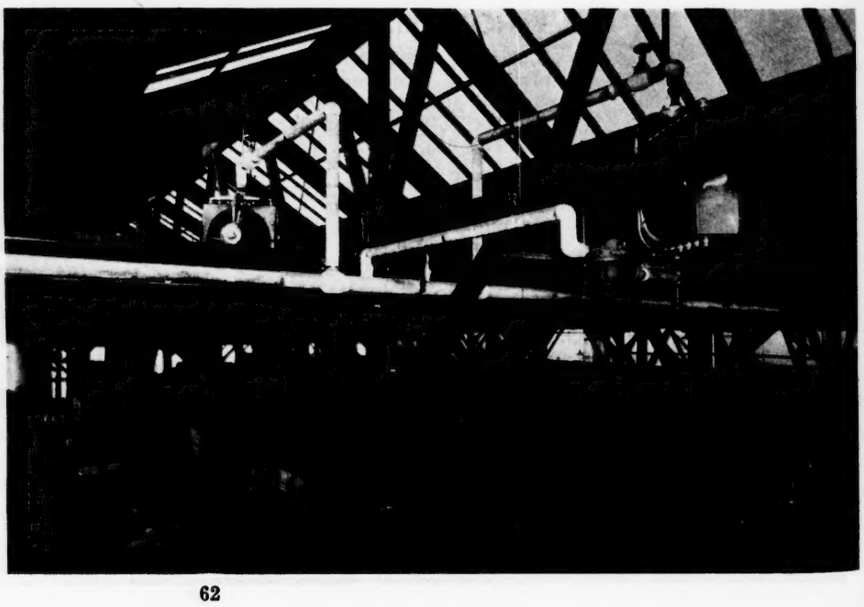
Editor of Heating and Ventilating for the past 26 years. . . . Mr. Armagnac has been closely associated with all of the major developments in the industry during the past quarter century. . . . Under his direction, Heating and Ventilating has taken the initiative and has been an important factor in the progress of the heating, ventilating, and air conditioning industry. . . . Heating and Ventilating will continue to have the benefit of his experience as Advisory Editor.

Design, Operating

ONE answer to the question, *Why is a unit heater?* is to be found in the design of the modern industrial building, where glass has become the principal element in the walls. The modern factory is often long and narrow to accommodate mass production methods, and the walls and monitors are nearly all glass. Because of the greater conductivity and increased window leakage, the heating loads tend to become excessive, and factory heating methods have been modified to meet these new conditions.

Another answer comes from the economic changes that have brought about the employment of large numbers of women in factories. Moreover, ten or fifteen years ago, the few women workers wore heavy clothing in winter as contrasted with the sheer, flimsy things they wear today. However, winters continue to be just as severe as formerly.

Still another answer is the increased use of labor-saving machinery, which necessitates higher maintained temperatures to insure com-



Above—Installation of High Velocity, Blow Through, Suspended Unit Heater in an Elevator Plant

Right—All Aluminum, Suspended Type Units Installed in Car Repair Shops

Characteristics and Selection of Unit Heaters

by **J. H. SMITH**

Chief Mechanical Engineer, The Ballinger Company, Philadelphia

fortable working conditions for the men and women who, with little physical effort, operate these machines.

There are definite indications in recent years that factory owners in general have become much more interested in the cost of operating their heating plants than formerly. They have more and more come to apply to their heating plants the same criterion that is applied to other parts of the plant, viz., that any expenditure in equipment is justified which can be shown to earn an attractive return. While it is true that heating equipment is not *productive* equipment, it indirectly affects the productiveness of every piece of machinery in a plant. If the operators are uncomfortably cold, or if their efficiency is affected by maladies contracted as the result of insufficient warmth, production from machinery is affected accordingly. Cost of fuel to heat the modern factory is an item which, if reduced only 20%, would amount to thousands of dollars in savings.

The old wall coil was a lazy contraption. A transmission factor of from 1.3 to 1.8 could be obtained, which means that with a steam pressure of 5 lb., an average of 250 B.t.u. per hr. per sq. ft. of surface would result. Since it has been conclusively demonstrated that the rate of transfer of heat from steam or water coils to air varies directly with the velocity of the air passing over the heating surface, it naturally follows that a higher transmission factor can be obtained by forcing air over the heated surface.

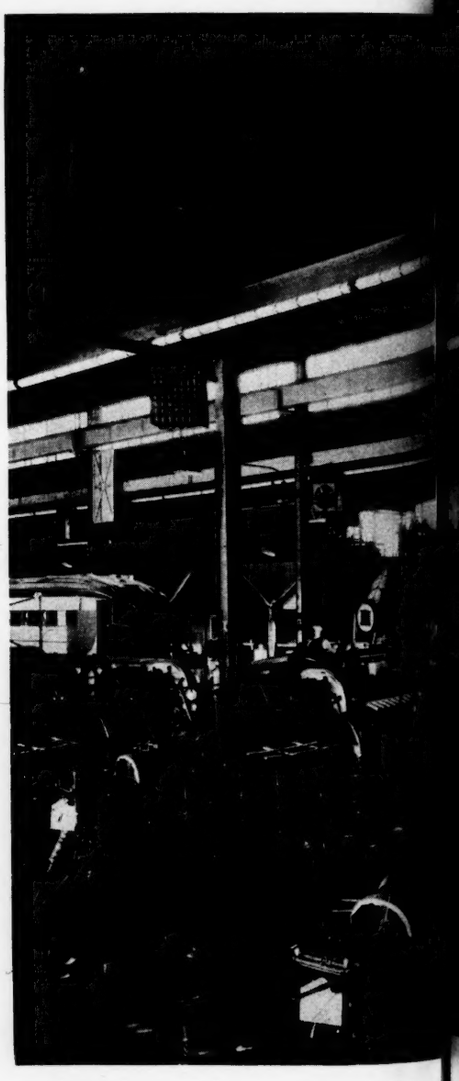
In the central fan or blower system, which has been widely used in factory heating, a considerable increase in the rate of heat transfer is effected. Because the fan in a central system is capable of moving air against a reasonable resistance, the velocity of the air passing over the heating surface is made as high as 800 to 1400 ft. per min. without

Draw Through, Floor Mounted Units, Blowing Away from the Wall Across an Inspection Room

undue expenditure of power. With a steam pressure of 5 lb., an average of 1400 B.t.u. per hr. per sq. ft. of surface can be obtained.

A unit heater system is similar to the fan or blower system in that each unit contains a bank of heating surface and a power-driven fan, or fans, all of which are self-contained. One or more units may be used as desired or required. Unlike the central blower system, no ducts or distributing pipes are used, but the air is discharged directly into the heated space through one or more short nozzles or outlets. Because of the omission of ducts, static resistance is reduced and most of the static pressure produced by the fan is available to induce the flow of air over the heating surface. This permits even higher velocities over the surface than in a central system and, therefore, secures a higher transmission factor. This is about 8 to 12, or an average of 1700 B.t.u. per hr. per sq. ft. of surface, with 5 lb. steam pressure. The magnitude of the steam distributing system will depend upon the number and size of unit heaters used, but in any case tends to be less complicated and less costly in installation than with direct radiation.

Heat losses from a building are directly proportional to normal temperature difference between inside and outside, but when the temperature difference in the upper areas becomes abnormal, the flow of heat becomes excessive, and at the same time the increased stack effect creates a greater inward leakage of cold air. The greatest economy of heating is obtained where the working area is kept at a uniformly comfortable temperature and where the temperature of the upper areas is kept to a



Floor Mounted Units Installed in Abrasive Manufacturing Plant, Blowing Longitudinally Through Building

Floor Mounted Units with Steel Heating Surface Installed in Electric Railway Shops

minimum. Because air in a building stratifies according to temperature, a temperature gradient between floor and ceiling is produced. This gradient is present regardless of the kind of heating equipment used, whether unit heaters, central fans, or direct radiators. Different types and designs of unit heaters set up different gradients, and it follows that the unit heater which operates with the least difference between floor and roof temperatures may be considered the most efficient and most economical in operation.

Available Types of Unit Heaters

At the present time, there is available a wide variety of types of unit heaters. They may be grouped in various ways, but the division given below should be of greatest use to the architect or engineer.

Design
- (a) Draw-through units
- (b) Blow-through units

Location
- (c) Floor-mounted units
- (d) Suspended units

Operation
- (e) High-velocity discharge units
- (f) Low-velocity discharge units

Draw-through units. In units of this type, the air to be heated passes successively through the inlet, heating surface, fans and outlet, thus being drawn through the heating surface by the fans. Centrifugal fans are generally used.

Blow-through units. In this type, the fan is located on the intake side and pushes the air through the heating coil. Either centrifugal or propeller type fans may be used.

Floor-mounted units. These are designed to draw the air to be heated from near the floor level and to discharge it horizontally, just above the head line. They may be of either the draw-through or blow-through type.

Suspended units. These are designed for location above the working zone and may be of either the blow-through or draw-through type. They are generally equipped with louvers or angular outlets for directing the air stream downward. They may take their inlet air from near the floor or from higher levels. When arranged with their inlet near the floor level, these units are really intermediate between floor-mounted and suspended types.

High-velocity discharge units. These are characterized by the use of centrifugal fans. They may be of either the blow-through or draw-through type and are available for either floor mounting or overhead suspension.

Low-velocity discharge units. Units of this type are characterized by their use of propeller fans. They are usually of the blow-through type, and are also available for either floor mounting or overhead suspension.

While most of these groupings are fairly clear-cut, it is difficult to distinguish between high and low velocity. In general, discharge velocities of 1200 ft. per min. or more are considered high, while velocities of 800

Suspended Mounted Units, High Velocity Type, Arranged to Blow in Various Directions in an Aeroplane and Motor Factory

An Installation of Blow Through Suspended Units with Copper Heating Surface in Doll Factory

ft. per min. or less are considered low. Velocities falling between these two figures may be considered intermediate.

Note: This article deals only with unit heaters intended for use with steam or hot water. While somewhat similar units are available for direct-firing, and are used for factory heating, the above grouping is not intended to apply to them.

Materials Used in the Construction of Unit Heaters

Materials most commonly used in the construction of unit heaters can best be outlined by dividing the unit into its vital parts and listing each separately.

Heating Coil. Copper: widely used for both tube and fin material because of its high conductivity and resistance to corrosion.

Aluminum: used either as fin material or as complete cast heating surface. Has the advantages of moderately high conductivity, moderately low cost and light weight.

Brass: used chiefly in the form of fin material.

Steel: extensively used in the form of pipe, and occasionally as fin material. Also frequently used as header material for non-ferrous heating surfaces. Low in cost.

Cast iron: lighter metals mentioned above appear to be replacing cast iron, except when used for headers. Has advantage of low cost per pound.

Fans. Steel, aluminum, cast iron, and occasionally copper. Design and application determine the material best suited.

Casing. Steel, copper or cast iron.

Outlets. Steel or copper.

Steel is most commonly used for both casing and outlets due to low cost and ease of fabrication. It readily lends itself to spot and arc welding. Copper and cast iron resist certain corrosive conditions.

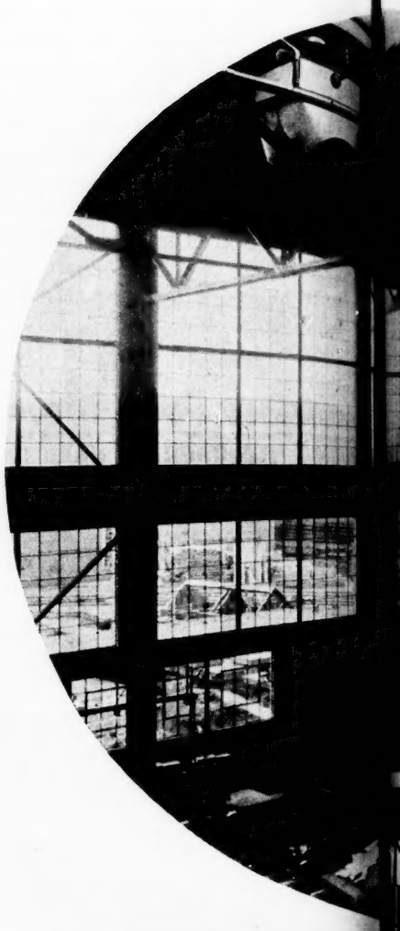
Elements of Design

A unit heater appears to be a simple piece of equipment which should require little thought in its design. Actually, however, it represents a fine balance of the numerous factors involved. It is impossible, in this article, to set forth all the definite rules or laws governing the design of industrial heating units, and for this reason, only the basic design features which vitally affect the performance of the unit will be considered.

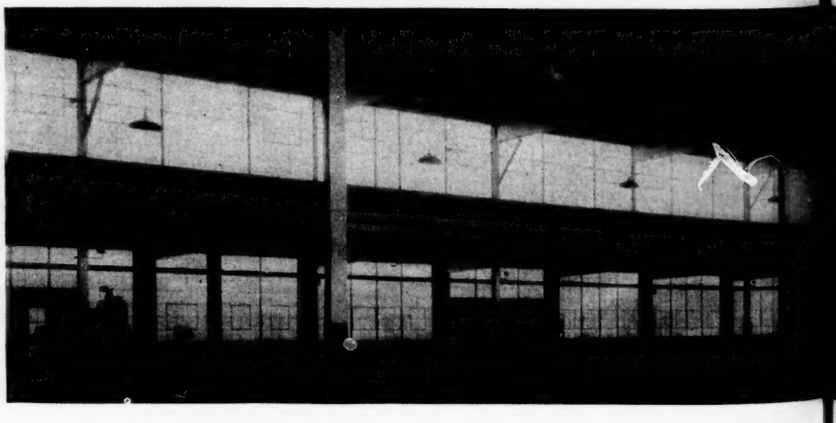
The field of application for which unit heaters are suitable is a broad one, calling for units that will operate satisfactorily under varied conditions. The designer of any piece of equipment must first set his major requirements. In unit heater work, B.t.u. capacity is normally the starting point. The second most important item is final temperature. With B.t.u. and final temperature set, the air quantity is automatically determined for a given steam pressure and entering air temperature. If a certain air volume is desired, final temperature for a given steam pressure and entering air temperature is fixed.

Conversely, if a definite final temperature is required, this in turn determines the air volume. In fixing the final temperature and c.f.m. (air volume) to be handled by the unit, the speed at which the fans operate, the coil resistance, and horsepower all take definite values. Due to the characteristics of the fan, any alteration of coil or casing resistance changes the c.f.m. delivered and in turn affects the B.t.u., final temperature, and horsepower. Thus, there is a definite balance between resistance, c.f.m., B.t.u., final temperature, and horsepower, and a change in numerical value of any one of these items unbalances the whole system.

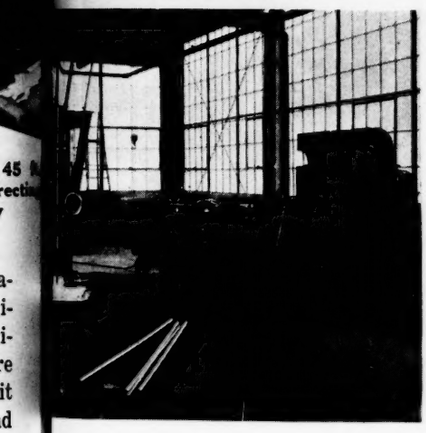
In many industrial unit heater applications, it is desirable to get the maximum capacity and distribution from a unit for a minimum cost. The more air handled, the greater is the B.t.u. delivery, the higher the outlet velocity, and the wider the distribution. Thus, for a given steam pressure and entering air temperature, a unit operating at its maximum speed is delivering its maximum output. On installations where quietness of operation is a factor, it is necessary to sacrifice capacity and discharge velocity to obtain the degree of quietness required.



These Suspended Units are 45 ft. Above the Floor in the Erecting Shops of a Bridge Company



Alternate Units of These High Velocity Heaters Blow in Opposite Directions Across the Plant



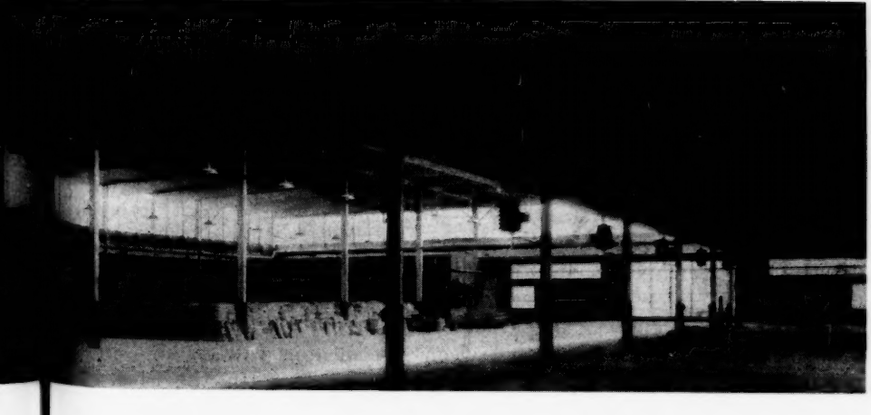
This Floor Mounted Unit Installed in a Machine Shop has a Capacity of over 500,000 B.t.u. per Hr. at 5 Lb. Pressure

The speed at which fans operate cannot be taken as a relative measure of quietness, since quietness depends upon the type of fan, blade form, diameter, fan housing, cutoff, discharge velocity, and other variables. All of these factors must be taken into consideration in the design of units.

Equal B.t.u. capacity may be obtained with a small air volume at high final temperature or with a large air volume at low final temperature. While the actual B.t.u. delivery may be the same in each case, the heating effect and fuel economy of the low final temperature, high air volume combination is far greater. The improved heating effect is the result of more rapid air change, wider distribution and lesser tendency for the warm air to rise to the ceiling. With the lower ceiling or roof temperatures obtained, the heat loss over these areas is reduced, thus requiring less fuel to maintain given comfort conditions in the working zone.

The fact that there is an economic balance between the cost of the increased size required for the larger air volume and lower final temperature, the saving resulting from its operation must not be overlooked. It is impossible to place a specific upper limit on the final temperature, but under most conditions it should be not more than 70° above the heater intake temperature.

It must be recognized that increasing the steam pressure increases the final temperature. In order to keep within the above mentioned limit and to obtain the resulting economies of operation, units with special low-temperature-rise coils should be considered when high-pressure steam is used.



Relation of Final Temperature to Discharge Velocity

Unit heater manufacturers normally utilize as high final temperatures as practical, because for a given quantity of air the B.t.u. capacity of a unit increases as temperature rise through the unit increases. However, there are other points to be considered, the most important being that with a high final temperature the air has a greater tendency to rise toward the ceiling before it has had a chance to dissipate its heat in the working zone.

It has been found that the air stream discharged from a unit heater at about 1700 ft. per min. will, by induction, circulate an additional volume of air at least equal to that handled by the unit itself. The temperature resulting from this mixture of room air and discharged air will be much lower than the final temperature at the unit itself, and this effective temperature is a measure of the buoyancy of the air. Units discharging at low velocity have little induction effect and consequently should be designed for lower final temperatures since they cannot depend upon a quick reduction of temperature by mixing with the surrounding air. In other words, the effective temperature obtained from a low velocity unit is practically the same as its final temperature, while the high velocity unit may have a much higher final temperature and still obtain the same effective temperature as the low velocity unit.

From the above, it would appear that the velocity should be made extremely high so that very high final temperatures could be utilized, but there are practical limitations which make extremely high velocities undesirable. First, air noise is a function of velocity, and if the velocity is too high the units will prove objectionable for many applications. Velocities of 1700 to 1900 ft. per min. have proven very satisfactory as far as freedom from air noise is concerned, and these velocities are sufficiently high to have the advantages of wide range distribution and induction (low effective temperature). Second, extremely high velocities result in excessive power requirements.

High velocity is desirable from the standpoint of both fuel economy and distribution, particularly in

large industrial buildings. In small rooms it would be unwise to use high velocities since the air stream would strike the opposite wall, rebound, and cause objectionable drafts. For such locations, low and intermediate velocities are preferable.

Distribution of Heated Air and its Relation to Discharge Velocity

There are two fundamental laws governing the action of air which are the basis upon which the unit method of heating depends. They are: (1) Heated air rises if uncontrolled, (2) Air is most easily moved horizontally within its own temperature level.

The fact that warm air rises is so universally known and accepted that it need not be dwelt upon here. The result of warm air rising is stratification, i.e., if undisturbed, the air in a building will seek different levels according to its temperature. The coolest air, being heaviest, will settle to the floor, while the warmest air, being lightest, will collect just under the roof or ceiling. Between these two extremes there are a multitude of air strata, graduating from the coolest air at the floor to the warmest air at the ceiling.

In explanation of the second law, cool air will offer resistance to being drawn upward, and similarly warm air will offer resistance to being drawn downward.

Let us now see how these two laws apply to the action of unit heaters. From the first law, we know that warm air will rise unless controlled. We must, then, control the warm air to obtain the greatest fuel economy.

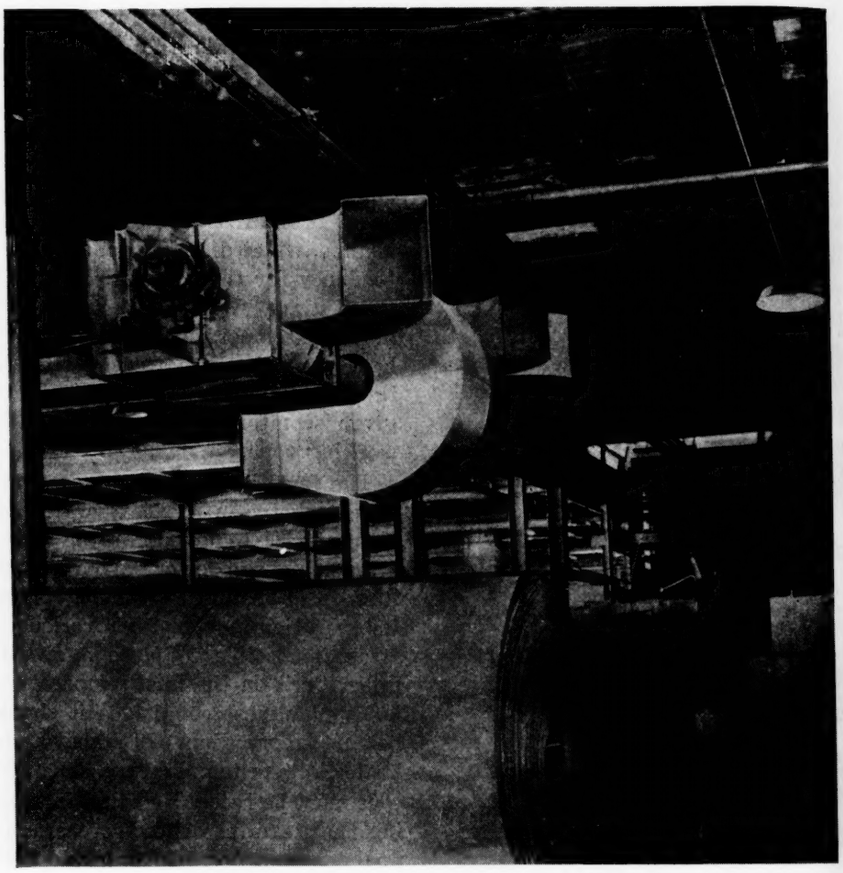
The only method of controlling the discharged air (at a given velocity) is by limiting the effective temperature. As pointed out above, with low velocity units the effective temperature is the final temperature, while with high velocity units the effective temperature is considerably below the outlet temperature. Therefore, if low velocity units are used, the final temperature should be reasonably low; if high velocity units are used, a higher outlet temperature may be used with equal results.

Where a suspended unit is used it is necessary to discharge the warm air downward in order to force heat into the working zone. This means that the warm air stream must penetrate cooler strata of air which offer a certain amount of resistance, and slow up the discharge stream. If the air is at a high temperature and low initial velocity, its force will be spent before it has had an opportunity to dissipate its heat, and it will quickly rise to the roof. If discharged at high velocity, the air will penetrate the cooler levels much more effectively. In both cases, the angle of discharge together with the velocity must be closely watched in order to prevent objectionable hot spots in the working zone. In all cases, the heat should be brought as close as is practical to the area to be heated.

With floor-mounted units, the warm air is discharged horizontally just above the working zone. The air stream is not penetrating the cooler strata of air and consequently will travel a greater distance than the air discharged from suspended units at a downward angle. Here again, however, the same reasoning applies concerning low velocity and high velocity. If the unit is of the low velocity type, the air stream soon loses its horizontal motion and will start upward since it is still warmer than the surrounding air. Naturally, a high velocity discharge will propel the air a greater distance.

Next, let us consider the location of the unit heater intake. From the second law we learn that air is most easily moved horizontally in its own temperature level. Thus, practically all of the air will be drawn from a horizontal plane at the level of the intake. Since a vacuum cannot be maintained in a portion of a building, the air which has been removed from the floor level by a floor intake unit must be replaced. Hence the warmer air from above moves in to occupy this space. Put another way, the warm air which has been discharged just above the working level has a force exerted upon it attempting to pull it toward the floor.

The above demonstrates that the primary circulation takes place between the heater intake and discharge. Therefore, in the case of



An Overhead Mounted, Horizontal, Draw Through Heater with Aluminum Heating Surface Installed in Paper Finishing Plant

suspended units where the intake is above the floor line, the principal circulation is overhead. Many manufacturers have recognized this and recommend recirculating ducts extending to within two feet of the floor thereby making, for all practical purposes, a floor-mounted unit of a suspended unit.

Effect of Intake Temperature on Capacity

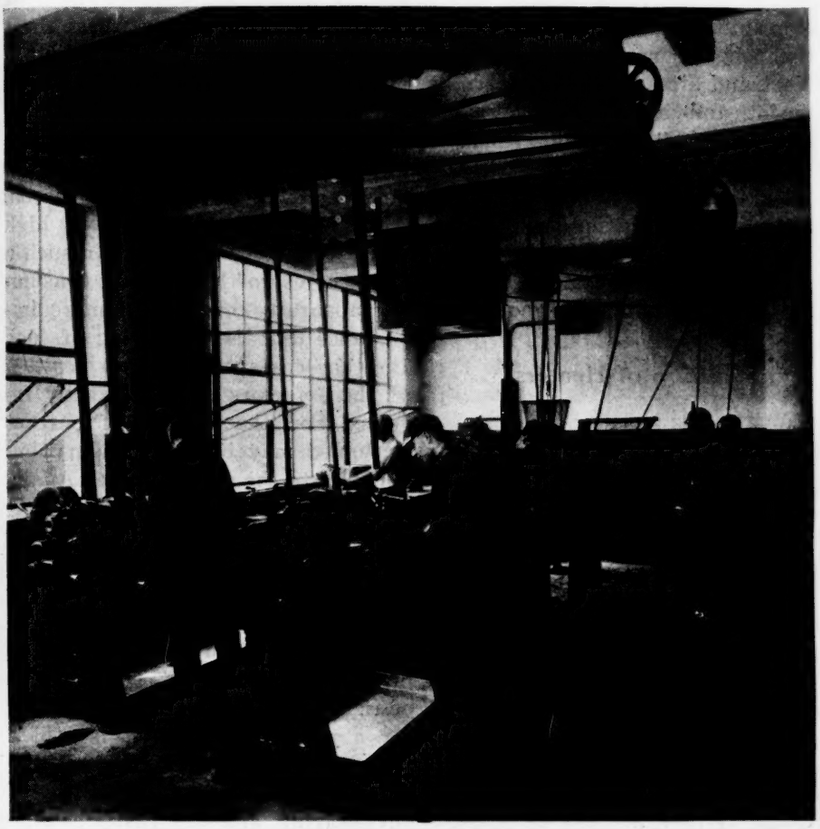
Floor inlet units take the coldest air which lies along the floor, heat it in passing through the unit, and discharge it just above the working zone. Suspended units, on the other hand, draw air from a higher temperature stratum and must, to be effective, discharge the heated air at a downward angle in order to force warmth into the working area.

Since the heat transfer through any surface is dependent upon temperature difference, it follows that the capacity of a unit operating at a given speed and steam pressure falls off as the entering air temperature increases.

No specific figures can be given for temperature gradients since local conditions, such as building construction, temperatures maintained, efficiency of units, etc., have a vital bearing. In general, however, the temperature rise per foot of elevation with high velocity suspended units is from 1° to 2° per foot (within the lower twenty feet), while the rise per foot of elevation for low velocity suspended units is from 1¼° to 2¼° (within the lower twenty feet). Thus, such a unit suspended ten feet in the air may have an entering temperature 15° to 18° higher than a floor-mounted unit. This increase in entering temperature would reduce the capacity of the unit about 15%, that is, the suspended unit should be 15% larger in heating surface than the floor-mounted unit if only one unit is to be used, or, on a multi-unit installation, 15% more units would be required under these conditions.

Location and Spacing of Units

The disposition of heaters in a building, their discharge direction and the distance between units depend so much upon the size and type of construction of the building itself, the processes carried on, and the type of heater, that few general rules can be given. In this phase of the discussion, we will deal with only



A Suspended Type Copper Heating Surface Unit Blowing Parallel to Wall in Small Machine Shop

Draw Through, Floor Mounted Unit, Installed Along the Wall of a Type Machinery Plant

two types of heaters, those having a low discharge velocity and those with a high discharge velocity.

In general, the low velocity units are limited to one direction of discharge per fan section and also their effective range of distribution is considerably less than that of units discharging at high velocity. On the other hand, each fan section on a high velocity unit may be equipped with an outlet discharging in either one or two directions and since this type of heater is generally built with from two to four fan sections, it can be seen that a wide variety of directions may be obtained from a single unit.

Unit of the high velocity type may be placed as far as 300 ft. apart in some cases (150 ft. discharge for each unit) while for the low velocity type a discharge of more than 60 ft. is to be avoided.

In selecting the location for low velocity heaters, it is often a good plan to place them in the central portion and discharge toward the exposed surfaces. Another system is to arrange the heaters along the exposed surfaces, discharging parallel and close to the cold walls. When this is done, it is well to have all units discharge in the same direction around the periphery of the building. In this way, the units aid each other in setting up a positive circulation around the building as a whole. In most cases it is not wise to have the units discharging at random since poor distribution may result when the units are bucking each other.

In the case of the high velocity type, the heaters may be arranged in the room so as to blanket off all exposed surfaces by blowing directly toward them or by blowing parallel to them. If the roof loss is considerable, it is well to direct part of the discharge toward the center of the room.

Every unit heater installation should be designed to carry the maximum heat load for the coldest winter temperature, yet the average heating load is usually less than half of this amount. Thus, to prevent overheating, the units must be operated either intermittently or at lower speeds during a considerable part of the season.

In order to produce best heating results in the wide variety of rooms encountered, the discharge outlets or nozzles should be easily adjustable to take care of varying conditions. It is also important that all vital parts, such as fans, motors and heating coil, be easily accessible for repairing, servicing and cleaning. These features make for low maintenance cost, rapid repair and long, uninterrupted service.

In addition to being so proportioned as to give a liberal air capacity for a given B.t.u. output, that will result in a low final temperature, good distribution, fuel economy, and comfort, a well-designed unit should have the following physical characteristics:

Portability.
Compact and rugged construction.
Neat and attractive appearance.
Smooth and vibrationless operation.
A heating coil that will withstand the strain of service without leaking.
Adaptable to accessory equipment, such as outside air intakes, damper, air filter, etc.
Fan driven by standard motor.

Selection of Heaters

Having noted the design and operating characteristics of the various types of unit heaters commercially available, we may now turn attention to methods of selection. So far, emphasis has been laid on the matter of fuel economy.

If the engineer were concerned only with fuel economy, the selection of the heaters for use in a particular installation would be a relatively simple matter. Mention has been made of the tendency of factory owners and managers to apply the criterion of economy and an attractive return to the selection of heating equipment. When viewed in this light, fuel economy, while still important, is not the only factor which enters into the choice.

The total annual cost chargeable to heating is made up of the following items: (a) cost of fuel, (b) maintenance, repair and upkeep, (c) labor, (d) fixed charges on the capital invested in the heating equipment, (e) cost of current.

The items of maintenance, etc., and labor are, roughly, independent of the particular type of heater selected. In general, it makes but little difference in the cost of annual maintenance and repair and in the labor chargeable directly to the equipment whether suspended or floor-mounted, or high or low velocity units are selected. Nor are either of these items normally a large percentage of the total annual cost.

Three items, then, are largely responsible for the total annual cost, and these items all vary with the type of heater selected. They are the fuel cost, the cost of current and the first cost of the equipment, if the annual fixed charges are assumed to be a fixed percentage of the first cost. The problem in selecting the type of heater for a given building is to find the one which will produce the most favorable combination of these three factors in the particular building.

It is evident at once that the relative importance of these items may vary widely. One plant may be blessed with an excess of exhaust steam during the heating season, while forced to pay a relatively high price for electric current. In such a case, the use of low current consuming apparatus may be of more importance than is the saving of fuel. In other cases, the relative position of these factors may be exactly reversed and the amount of current consumed may be of secondary importance to the saving of fuel. Again, a certain factory may be in a particularly favorable position to secure a given type of equipment at a low first cost, while another is not.

Because of the possible wide variation in the relative importance of the principal items of cost, the selection of the type and make of unit heater for a particular building is still a matter for individual study and solution. General rules have little, if any, bearing, and may easily be misleading. Final decision should never be made without due consideration of the relative importance of the several items of cost.

In approaching a given problem certain types of heaters may be eliminated at once because of structural, operating, or dimensional limitations, but very often it will be found that several arrangements and types of units are possible and apparently equally desirable. In such cases the actual selection can often be made only after complete layouts of each has been made, each carefully estimated for first cost, and the resulting combinations of the cost factors have been analyzed.

Designing an Industrial Service Boiler Plant

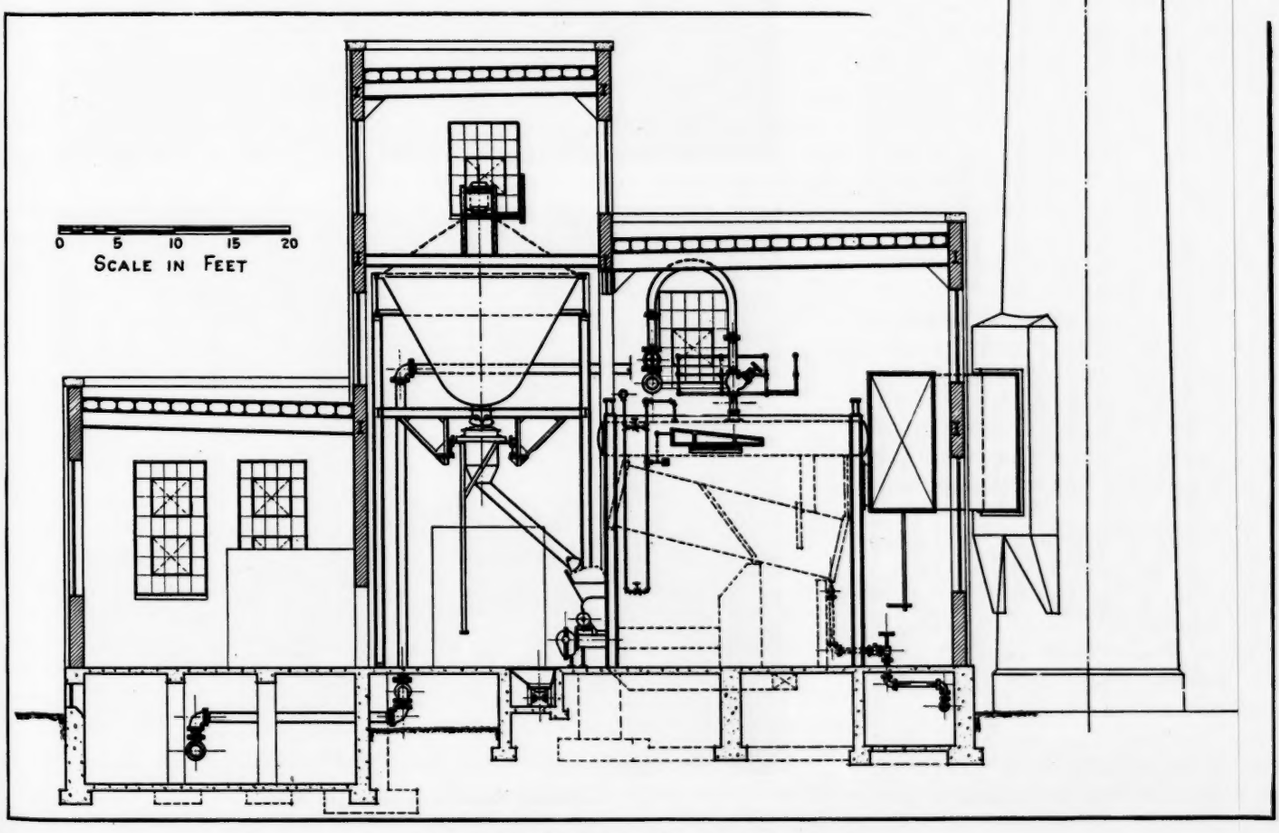
by **R. W. NOLAND**

Consulting Engineer, Fort Wayne, Ind.

SINCE an ever increasing number of factories and institutions are purchasing electrical energy because of economical reasons, industrial and institutional power plants are gradually being replaced by what may be termed "service boiler plants." Boiler efficiency in a well designed plant of this type compares favorably with that prevailing in a power plant of equal size. Usually steam is generated at medium pressures in order to facilitate distribution and to meet the demands for steam which is needed for process work. In industrial plants where there is no process work requiring steam the service boiler plant is simply a low-pressure heating plant. This article treats with the boiler plant which supplies steam for all purposes except the generation of power.

The purpose of this paper is, first, briefly to outline the fundamental factors affecting the design and, second, to present a brief description of a complete new industrial boiler plant designed strictly as a service plant.

It is not the writer's purpose to deal with the economical reasons for the passing of the small power plant and the general trend for industrial plants, institutions and large users



Longitudinal Section Through Boiler Plant

of electrical current to turn toward purchased electrical energy, but to discuss a type of boiler plant being developed as a direct result of this trend toward purchased electrical energy. The trend is so marked that the designing engineer must make a careful analysis of the local power situation before he proceeds to recommend and design an isolated power plant, whether it be for a factory, institution or municipality. However, it is possible in each individual case to actually determine whether or not electrical energy should be purchased or generated in the owner's plant.

Since it is undoubtedly much cheaper to generate electrical energy in the large central power stations, it is reasonable to assume that the time will eventually arrive when, except in very special cases, the isolated power plant will be as obsolete as the coal oil lamp.

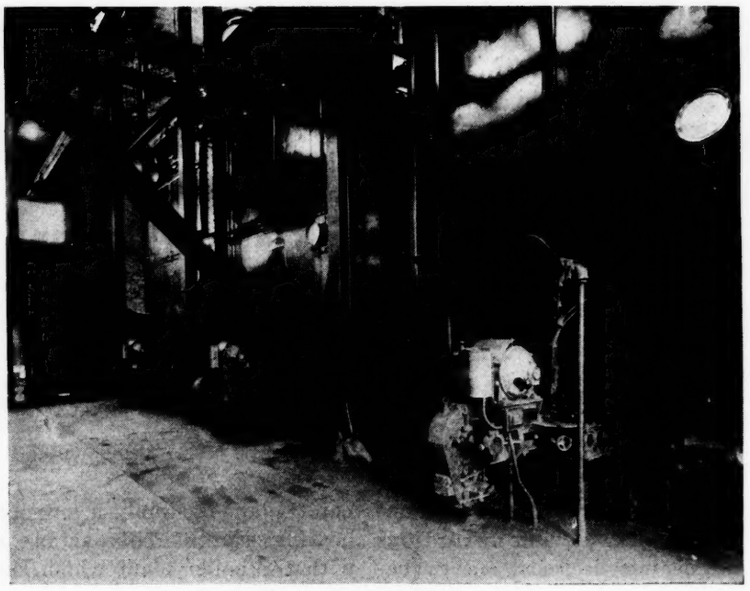
Design Procedure

Analysis of Load Conditions: A complete analysis should be made covering both power and steam load conditions. It should cover a typical year and take into consideration, as far as possible, the future growth of the plant.

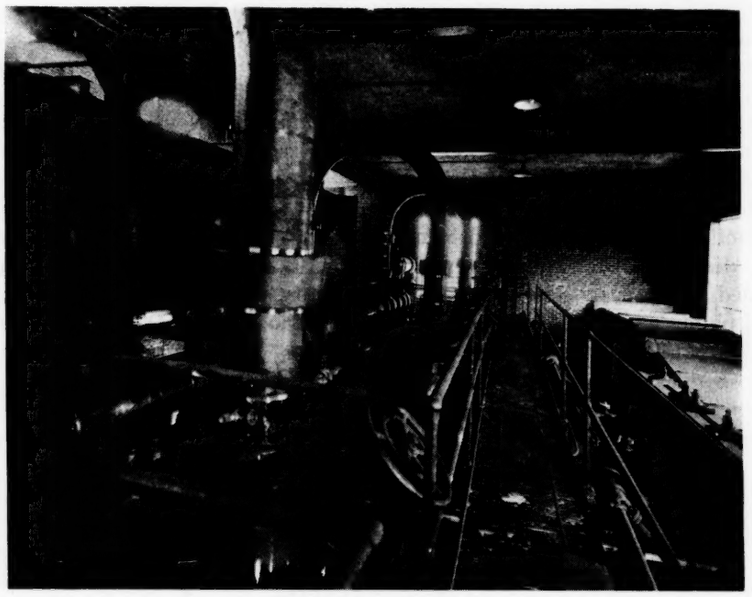
In working up these data, daily, weekly, monthly and yearly load curves should be developed. Often, in the case of an old system, an analysis of actual existing conditions must be compared with a theoretical analysis based on modernized heating and electrical distribution systems.

Determination of Proper Source of Electric Current: In every case, no matter how apparent the solution seems to be as to whether or not current should be purchased or generated in the owner's plant, the engineer should make a thorough investigation of all existing conditions before deciding this most important point.

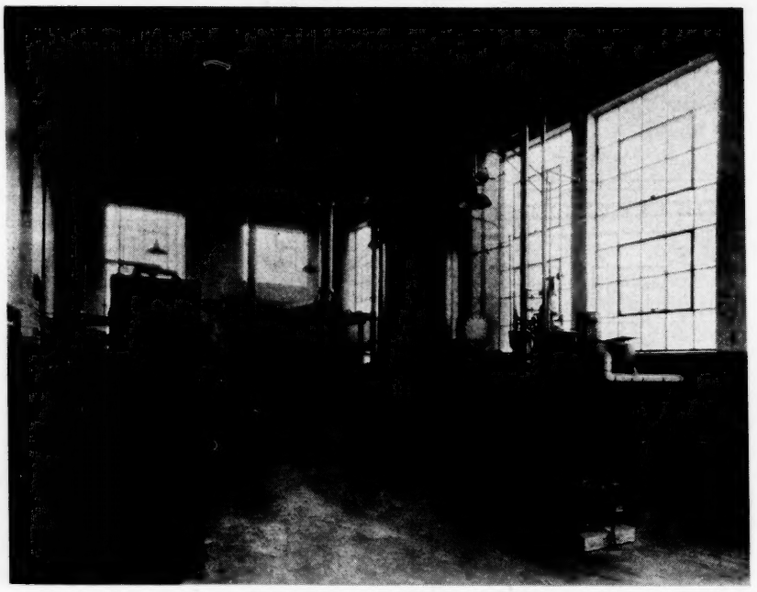
In order to arrive at the proper solution, the load conditions as analyzed must be carefully studied. The theoretical amount of available exhaust steam must be calculated, the process steam load thoroughly analyzed, and the electrical load carefully checked. An estimated first cost of the service boiler plant must be compared with the estimated first



Boiler Room Interior



Piping Over Boilers



Looking West in Equipment Room

cost of a complete power plant, operation costs of each plant analyzed, the cost of purchased electric energy estimated, fixed charges on the investments estimated and, finally, one must be balanced against the other and a yearly estimated total cost of each type of plant must be made.

Detailed Analysis of Steam Load: Steam load conditions should be carefully studied and the steam demand for process work and for heating plotted out in terms of pounds of steam per hour for the typical year. A maximum and minimum demand curve must also be made. It must be remembered that general conditions, only, are being discussed and that in each special case it may be necessary to work up other load curves.

Determination of Boiler Pressure to be Carried: Before proceeding with the design, the pressure which is to be carried upon the boiler plant should be decided upon. Since the first cost of the plant depends somewhat upon the pressure carried, it is important to be careful in making this decision. It will be necessary to know definitely the highest pressure which is needed in the process work in the plant. The boiler pressure carried should be higher by a comfortable margin than the maximum pressure required for this process work.

Auxiliary equipment, such as soot blowers and steam-driven pumps, are also factors which must not be lost sight of in determining the operating pressure.

General Type of Plant and Selection of Boiler Units: Type and size of the boiler unit are determined by the maximum and minimum load conditions.

A good condition exists if the individual unit is of such capacity that one boiler can carry the minimum summer load when it is operated at full load, even though three or more units are required for maximum winter conditions.

In the larger type of plant, water-tube boilers will undoubtedly be selected; in smaller plants, boilers of the fire-tube type are used. It is not general practice to install units so small that over four units are necessary, although there may be exceptions to this rule. Even under the most severe maximum load conditions the installation should be of such size that a standby unit is always available.

Due consideration must be given to probable future expansion and, if necessary, provision must be made for additional units.

Since it is customary to operate water-tube boilers at overloads of 200% or more, this factor must be taken into consideration in the design of the service boiler plant in which water-tube boilers are to be installed.

Chimney: In determining the proper size of the chimney, due consideration must be given to the future expansion of the plant.

Regarding the type of construction, the radial brick chimney is probably the most popular type, although the reinforced concrete chimney is being constructed in a successful manner at the present time. It is well to investigate the first cost of each type of chimney before making the final selection.

Design and Selection of Boiler Feed Pumps: Steam-driven boiler feed pumps automatically controlled may be the most logical type of equipment to install in this type of plant, although with the high degree of perfection to which centrifugal pumps have been developed with both steam and electrical drives, a careful investigation should be made before the decision regarding pumping equipment is reached.

If it is possible to use all of the exhaust steam from steam-driven pumps in treating make-up water, the decision will probably be in favor of the steam-driven unit. If, on the other hand, electrical power is very cheap and there is no use for the exhaust steam, electric motor-driven units may be the more economical. With all these facts available in any individual case, it is not difficult to make the proper selection.

In selecting boiler feed pumping equipment in a plant of this type, not less than two units should be installed either of which is capable of handling the plant under full-load conditions.

Make-up Water Treating Equipment: If any considerable amount of steam is used for process work, it is very likely that a large amount of make-up water is necessary. In case this is true, this make-up water must be analyzed and, if necessary, water treating equipment properly designed for treating the water must be installed. Many otherwise good plants have given a lot of trouble because this phase of the investigation was neglected.

Feed Water Heater or Main Receiver: It is good practice to collect all returns and make-up water in one main receiver or feed water heater. The boiler feed pumps are installed between this receiver and the boiler.

Automatic Stoker Installation: A plant of this type should be equipped with a high-grade automatic stoker installation, of the type which will burn economically the cheapest coal available in the district in which the plant is to be erected. It is important to be certain that the stokers are of sufficient size and rating to carry the full boiler overload without interruption and for as long a period as is necessary during the severe winter months.

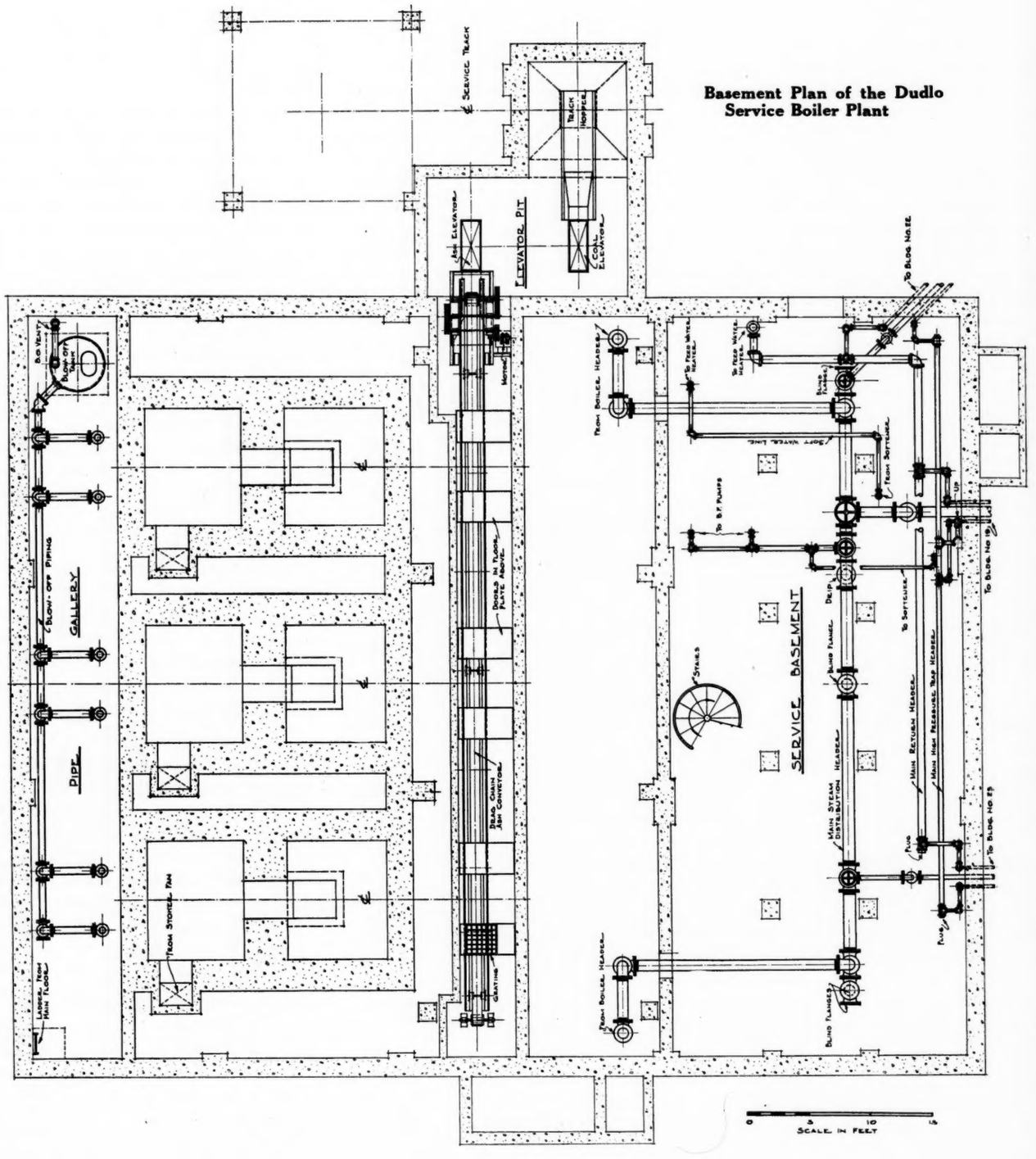
In connection with the stoker design and installation, the question of forced draft must be decided. It is good practice to install separate and independent forced draft units for each boiler if the summer load involves the use of one boiler unit only.

Coal and Ash Handling Equipment: Design of the coal and ash handling equipment will be affected very largely by local conditions. In general, standard power plant practice can be followed out in the selection of coal and ash handling machinery. Overhead bunkers for the coal with a weigh lorry to distribute it to the various stokers is good design in the larger plants.

Ashes may be dropped into a traveling conveyor beneath the floor and from thence carried into an ash storage from which they may be removed when convenient.

In designing this equipment, simplicity and ease of operation and maintenance should be carefully considered.

Recording and Indicating Instruments: A complete installation of recording and indicating instruments plays just as important a part in this type of plant as it does in the most intricate and complicated power plants. Systematically kept plant records will do more toward holding up operating efficiency than anything else. Money spent for a proper instrument installation will always pay high returns on the investment.



Basement Plan of the Dudlo Service Boiler Plant

Normally, the instruments installed should include steam-flow meters, provided with both integrating and recording devices; recording CO_2 indicators; recording pressure gauges; indicating and recording draft gauges; indicating and recording flow water meters, and other instruments as the special case may demand.

After the plant is put into operation a special plant record sheet should be designed so that it will be possible to make a daily check-up of plant operation.

General Scheme of Steam Distribution: In a plant of this type special care must be given in the design toward distributing the steam in an economical and convenient manner. A large and roomy basement or distribution room with ample clearance for valves, branches, main returns, etc., should be provided.

Usually it is best to distribute the steam over the plant by means of full pressure mains. Pressure regulating valves are installed wherever necessary to reduce the pressure as desired at the particular point.

A system of high-pressure returns serving high-pressure drip traps may be installed to return high-pressure condensation to the main receiver.

It is usually more economical to install individual vacuum pumps,

condensation pumps, etc., for the buildings served, these pumps discharging into a common return which is carried back to the main receiver. In any specific case, modifications of this general scheme may be necessary.

Description of Typical Example

In order to illustrate a practical application of the general principles involved in the design, a simple plant of this type, designed by the writer, will be briefly described.

The plant is that of the Fort Wayne factory of the General Cables Corporation, formerly known as the Dudlo Manufacturing Company.

This boiler plant has been selected as a typical example because of the fact that it is entirely new and the designer was unhampered regarding location or space requirements, as there were several acres of ground available on which to locate and build the plant. It was designed along very simple lines with the idea of economy of design and operation continually uppermost.

In connection with the design of the boiler plant proper, new heating plants were designed for several of the buildings and a complete new distribution and return system was designed and installed. The design of this distribution and return system was, from necessity, influenced by the existing heating systems, as it was necessary to utilize as much existing equipment in the buildings as possible.

Existing Conditions: Due to the rapid growth and expansion of the industrial plant in question, it was decided by the management early in the year 1929, that an absolute necessity for a new boiler plant and general remodeling of the steam heating and distribution system existed. A general engineering survey was made with a view toward ascertaining the steam load conditions. The present plant, including the new buildings which were erected in 1929, consists of some twenty-three buildings of various types, ranging in height from one to four stories.

As is usual in cases where construction has been developed over a considerable period of years, all types of heating systems were found in these buildings.

The later factory buildings are equipped largely with unit heaters supplied by vacuum systems of steam circulation. The new office building is equipped with a modern vacuum system of the direct type. Many of the older factory buildings are equipped with gravity systems of direct radiation. The radiation includes both pipe coils and cast-iron radiators. Considerable steam is used in process work at pressures as high as 80 lb. per sq. in. Careful analysis of the process loads were made and tabulated.

The heating load was based on a complete series of calculations of the actual heat losses of the various buildings, taking into consideration the types of heating systems which were installed therein.

Probable future expansion of the plant was carefully considered. These conditions were plotted in the form of load curves so that the proper study could be made of the actual conditions. By means of these collected data decisions were made regarding the proper type and size of boiler plant to be designed.

General System of Steam Circulation: The buildings occupy a considerable area. Steam is distributed at full boiler pressure through the main steam distribution system. This pressure is reduced before it enters the various heating systems, reducing stations being located at strategic points.

Vacuum pump stations for collecting the returns from various groups of buildings are located at central points. These pumps all discharge into one main return line, which is carried back to a booster pump and, from thence, back to the main receiver in the boiler plant. Wherever necessary, high-pressure drips are carried back to the main receiver located in the boiler plant.

Boiler Plant Pressure: It was decided to generate steam at a normal pressure of 110 lb. per sq. in. gauge.

Location of Boiler Plant: The boiler plant was located at a point which will be a central location when the future contemplated extension of the plant has taken place.

General Scheme of Boiler Plant: Three 350 hp. water-tube boilers of the B. & W. type are installed. These are served by center retort underfeed stokers of the side dump type, with a rating such that each boiler can be carried continuously at 200% rating.

The main steam header is of the loop type, one end of the loop being over the boilers and the other in the basement room which is designated on the plans as the service basement. This basement is very roomy and ample provision is made so that any future demand for new lines can easily be met.

At the present time the three main steam lines as indicated have been connected into the header and supply steam to all of the present factory.

Above the service basement is located what is designated as the equipment room. This equipment room contains the hot-water process water softening equipment; the boiler feed pumps, and the feed water heater, as well as some special equipment such as water softeners, which are not a part of the boiler plant proper.

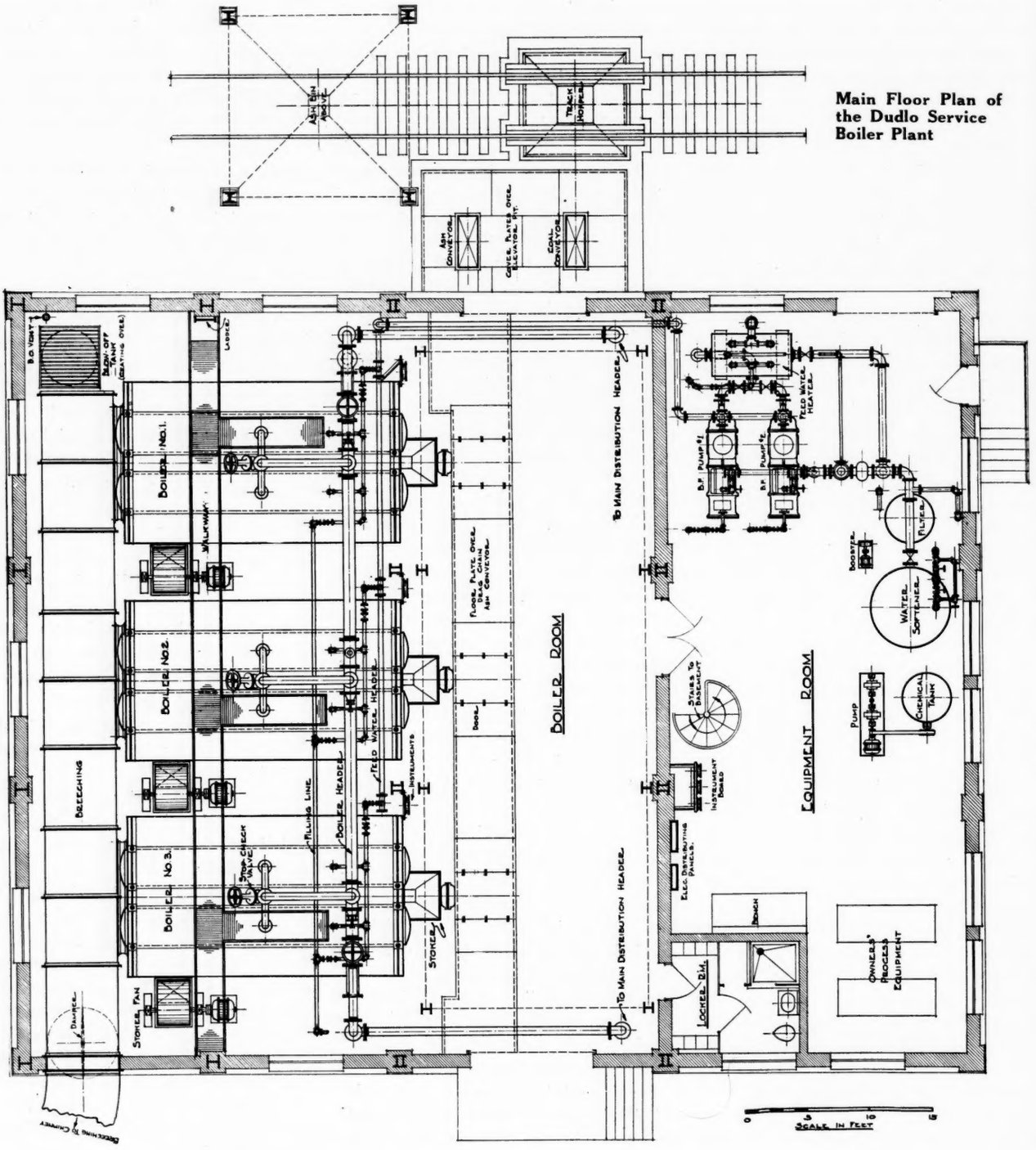
Coal is supplied to the boilers from the overhead bunkers and a motor-driven weigh lorry distributes it to the hoppers of the stokers. Coal is dumped into the track hopper and, by means of a coal elevator and overhead horizontal conveyor, is carried to the overhead coal bunkers.

Ashes are carried to the ash elevator by a drag link ash conveyor located beneath the floor. The ash elevator then deposits the ashes in the overhead ash storage, which is located over the railway track serving the plant.

Each boiler is equipped with an individual stoker fan. Stoker fans and stokers are driven by electric motors. This drive was decided upon because of flexibility and the cheapness of purchased power. Boiler feed pumps are of the steam-driven reciprocating type. Exhaust steam from these pumps is used in connection with the hot process water treating equipment, so that there is no loss chargeable to exhaust.

The chimney has been offset so that an additional boiler can be installed in line with the three present boilers in an extension of the plant building in case unlooked-for expansion develops.

Complete indicating and recording instruments have been installed so that accurate plant records can be kept. These instruments include automatic CO_2 analyzers equipped both with indicating and recording



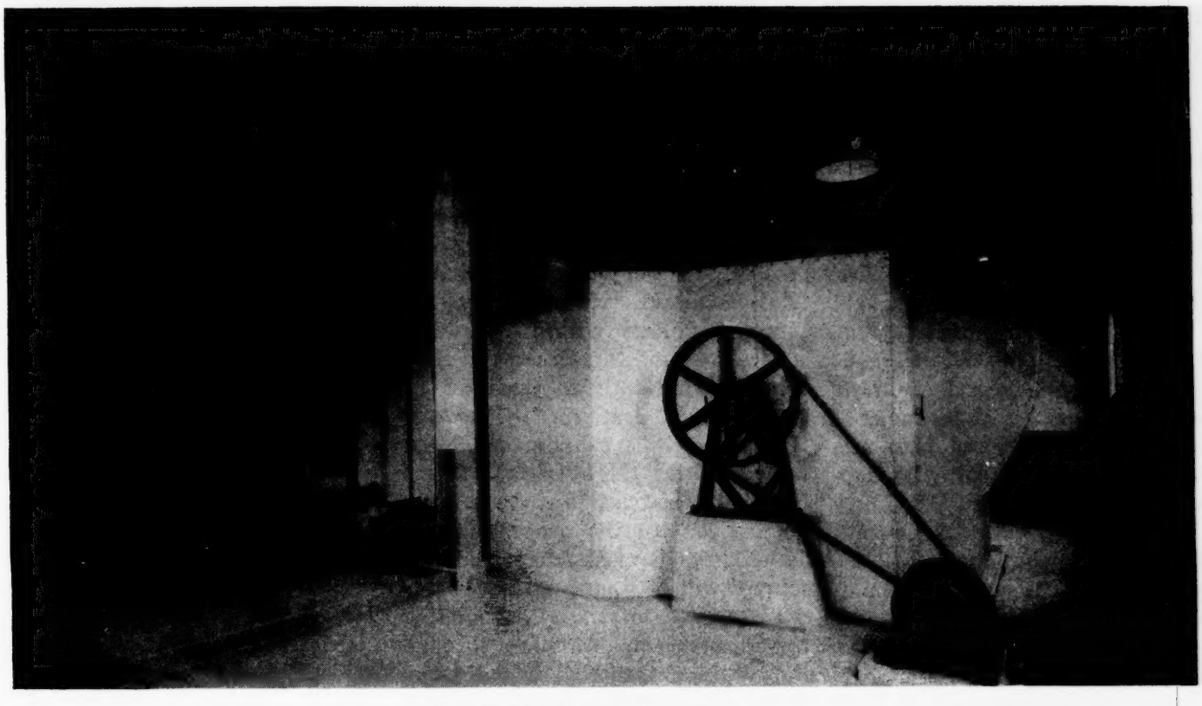
Main Floor Plan of the Dudlo Service Boiler Plant

devices; steam flow meters on each boiler equipped both with recording and integrating devices; complete automatic draft gauge indicators; pressure indicating and recording gauges, and all necessary water and electrical metering devices.

The plant is now in operation and a system of plant records is being made up so that a complete check-up of the plant's operation can be made every 24 hours.

Foundations are of heavy reinforced concrete construction, and the building proper is steel-framework construction with brick curtain walls; coal bunkers are carried independently of the building on separate steel construction. While compact, the building is light and roomy and serves its purpose satisfactorily.

In designing this type of plant, the engineer should keep in mind that he is designing neither a power plant nor a heating plant, but rather a special type of plant involving distinctive characteristics of its own.



Central Air Conditioning Equipment

Air Conditioning for Windowless Industrial Buildings

by **J. W. MC A. KREUTTNER**

Mechanical Engineer, The Cooling & Air Conditioning Corporation

FOR several years there has been a growing realization on the part of employers that human efficiency may be raised by surrounding the worker with more comfortable conditions. This is especially true of the office worker who has been favored so far in that a number of employers have furnished special furniture, special illumination, air cooling and conditioning systems, and various other features to make his surroundings more pleasant.

Apparently the money spent on improving conditions has proved a sound investment, for many of the new office buildings, and some old ones, are being arranged to include the above-mentioned items.

Comfort for the office worker, therefore, may be taken to be an assured development. Comfort for the entire working force in an industrial plant seems a logical corollary. However, universal comfort throughout a large plant has been slow in appearing, and though it has been discussed as a theory by many large corporations, it is only recently that any real attempt has been made to test its actual value.

Naturally, with an entirely new major consideration, the architectural designs have changed. For one thing, many more industrial buildings are being insulated, ostensibly against heat losses during the winter. This measure makes it possible to supply the air volumes necessary for comfortable conditions with less increase in operating expense than was obtainable when insulating materials were not used.

Another and generally overlooked advantage in the use of insulation is that it sometimes cuts down osmosis, or the permeation of moisture through the walls. It is known that with a permeable partition, such as a brick wall, if high humidity air is on one side and low humidity air on the other, there is a tendency for moisture to condense on the high humidity side and to evaporate on the low side after passing through the wall.

In the winter this would usually mean that the relative humidity inside a room would have a tendency to drop, and in summer to rise. Such an occurrence would make the interior conditions more uncomfortable, and insulation, if it does not prevent, at least materially retards this action. Other minor changes have been made to meet the new re-

quirements, but not until recently have they become revolutionary. Many variations in design have been evolved by the architects, but for the purposes of this discussion we will pick out only the salient features.

Of most interest to the air conditioning engineer is the fact that a great many new industrial buildings are being built without windows. This may be a startling statement but a window, by definition, is an opening to admit light and air. Some new buildings have no such openings, although they have glass sections in the walls and roof. These glass sections are fixed and tacitly presuppose artificial ventilation. This may be the first step toward the time when all those buildings will be provided with adequate air conditioning systems.

To return to the building design, further discussion will be limited to the two most unusual types. Both have received some publicity and both have strong advocates. The fact that at least one of each type is, if not in actual course of construction, in immediate prospect, makes this analysis a timely one. The two designs are, first, all glass walls, and second, all brick walls. The inherent advantages and disadvantages of the two designs are probably many and involved, and it is outside our province to sit in judgment regarding relative merits, but we can, at least, discuss the relationship of the two designs to air conditioning, the necessity, the problems encountered, and the methods employed.

In most respects, the two types of building are diametrically opposed, the designer of one casting an overwhelming vote in favor of natural lighting, and the other openly sneering at the sun to favor a man-made and controlled illumination; the first making all wall surfaces translucent and the second making all walls opaque. Both designs have as an object better illumination for the worker, and both are the results of exhaustive studies on the part of architects and engineers. The results obtained, and the relative merits of each, can be tabulated, compared, and discussed to the heart's content of the respective proponents in the very near future, when one of each type will be completed and put in use. Both buildings are being designed without any openings to provide natural ventilation, and it is this that is of chief interest to us now.

Regarding the necessity for air conditioning in either style of proposed building, it will be found that, aside from ventilation, air conditioning and cooling will be required to make the experiment in any way successful. In the present style industrial structure where there are sources of heat within the walls, such as the power required for operating machines, heat given off by processes, and heat from the workers themselves, it is usually found that in hot weather the temperatures and humidities become, to say the least, oppressive. In the proposed styles of building the heat from incidental sources will be even greater.

In the case of the glass building the resistance to heat flow through the walls is greatly reduced and, therefore, with less resistance to heat inflow from outside, the internal temperature will be markedly higher in summer. In the brick building the resistance to heat inflow will be greater than usual, but the heat given off by the lighting system will be tremendous. Neither building will have the infiltration of air through window cracks usual in the past.

Thus it can be seen that in order to make either one a workable arrangement, cooling of some sort is a necessity, and for almost the same reason control of the humidity is necessary to prevent excessive moisture content in the air which will result in too high effective temperatures.

For illustration and lucidity of explanation, a hypothetical case can be assumed. An employer intends erecting a building in which certain processes will be carried out and a stipulated amount of work done. The floor dimensions are limited by the plot of ground available and the number of stories by the work to be accomplished. The internal sources of heat are fixed and it is established that the building will be used for ten hours each day.

The requirements are outlined, and architects are called upon to submit designs. Two finally are selected as being suitable, one having glass walls and the other 13 in. brick walls. The roofs of each are of the same construction, the floor heights the same. The relative merits of each type of building are thoroughly investigated and the question of cooling, heating, and conditioning the air arises.

Perhaps if a definite shape and size are used for illustration, more definite conclusions can be reached, so we will assume the building to be erected will have several floors, each 100 ft. long by 60 ft. wide, 12 ft. high. We can now base our comparisons on actual calculations.

The heat to be removed per floor in summer will be:

I. For the glass building:
$H + 3840 \text{ sq. ft.} \times U_1 \times (t_1 - t_2) + 1200 \times s_1 + h_1$

II. For the brick building:
$H + 3840 \text{ sq. ft.} \times U_2 \times (t_1 - t_2) + 1200 \times s_2 + h_2$

Where

H = Internal heat load,

U_1 = Transmission factor for glass = 1.1 B.t.u. per hr. per sq. ft.

U_2 = Transmission factor for 13 in brick = 0.295 B.t.u. per hr. per sq. ft.

$t_1 - t_2$ = Difference between inside and outside temperature in degrees F. = 14° Max.

s_1 = Sun's radiant heat absorbed by glass = 25 B.t.u. per sq. ft. per hr.

s_2 = Sun's radiant heat absorbed by 13 in. brick = 8 B.t.u. per sq. ft. per hr.

h_1 = Heat given off by artificial illumination in glass building.

h_2 = Heat given off by artificial illumination in brick building.

Note: The value of s_1 given above assumes white muslin shades over glass surfaces exposed to the sun's direct rays, and the value of $t_1 - t_2$ assumes a temperature of 94° F. outside, with 80° F. maintained inside, normal maximum conditions encountered. The values of h_1 and h_2 are assumed to be 0 and 3W per sq. ft. $\times$ 3.41

Now the two equations become:

I. $H + 59{,}200 + 30{,}000 + 0 = H + 89{,}200$ B.t.u.

and,

II. $H + 15{,}850 + 9{,}600 + 61{,}300 = H + 86{,}750$ B.t.u.

The difference between the two heat quantities as given above is negligible and the maximum cooling requirements can be assumed to be

the same if the assumptions regarding the artificial lighting load will be allowed. This means that the size of the central air conditioning and the artificial refrigeration plant will be the same.

In winter the heating system for the glass building will have to be approximately 275% greater than that for the brick, during such times as the outside temperature is at 0° and there is no heat generated in either building by the process or the lights. When the lights are on and heat is being generated by motors and occupants, the heating effect necessary for the glass building is nearer 2,000% greater than that required for the brick building, but this is because the latter is heated almost entirely by the heat given off by the lights, consequently the cost of heating and lighting combined is not very different for the two buildings.

The heat load, amount of air, refrigeration requirements, and heat losses having been determined, problems of distribution, arrangement, and design are to be met. Drafts are always a lurking menace to be avoided, and with the peculiar building construction and abnormal heat distribution in these two instances, draft elimination becomes more involved than usual.

Since large difference between the maintained temperature and the temperature of the air delivered from the distributing ducts generally causes objectionable air currents, care must be taken to keep this difference as small as possible. This usually is accomplished by mixing cold air from the dehumidifier with air at the room temperature in such proportion that the total heat content and the moisture content of the delivered air mixture will give the required temperature and humidity when it has absorbed the excess heat in the conditioned room.

Horizontal distribution, with a centrally-located duct discharging toward the outside walls, normally makes automatic control of the maintained temperature and humidity simpler and more accurate, and is preferable if the sources of heat are evenly distributed over the whole floor area. But with the special conditions encountered here, general rules must be disregarded.

Leaving the brick building for the moment, and concentrating on the problems met with in the glass construction, it will be found that in spite of the large amount of heat inflow due to the low resistance of the glass surfaces, the major heat source will be encountered within the building, away from the walls. This is true of most industrial plants, where heat from processes and occupants is much higher than the other variable gains.

The summer distribution can be treated in two ways, equally effective. Horizontal duct runs can be used to supply the air in two directions, toward the walls and toward the center of the room, or occasional vertical branches against the outside walls directing most of the air toward the room's center and the rest at right angles, across the wall surface. This of course does not decide the method to be used, for the winter distribution must be considered before making a final decision.

In winter there is an additional problem requiring solution—the condensation of moisture on the inside surfaces of the glass. To maintain comfortable interior conditions, and to take full advantage of the air conditioning system, a relative humidity of 40% should be maintained, and with glass walls and a 0° F. outdoor temperature, moisture will condense in large quantities on the glass surfaces unless special means of prevention are used.

The two most effective methods would be to discharge hot air over the glass, or to use direct radiators to care for the winter heat losses. Both methods are feasible, the one involving the use of radiators being more expensive to install, although it offers several advantages.

If all heating is to be done indirectly by heating the supplied air, it will be found that with all the heat losses occurring at the walls, and in order to provide proper circulation throughout the room, it is very necessary to discharge low temperature air toward the center of the room,

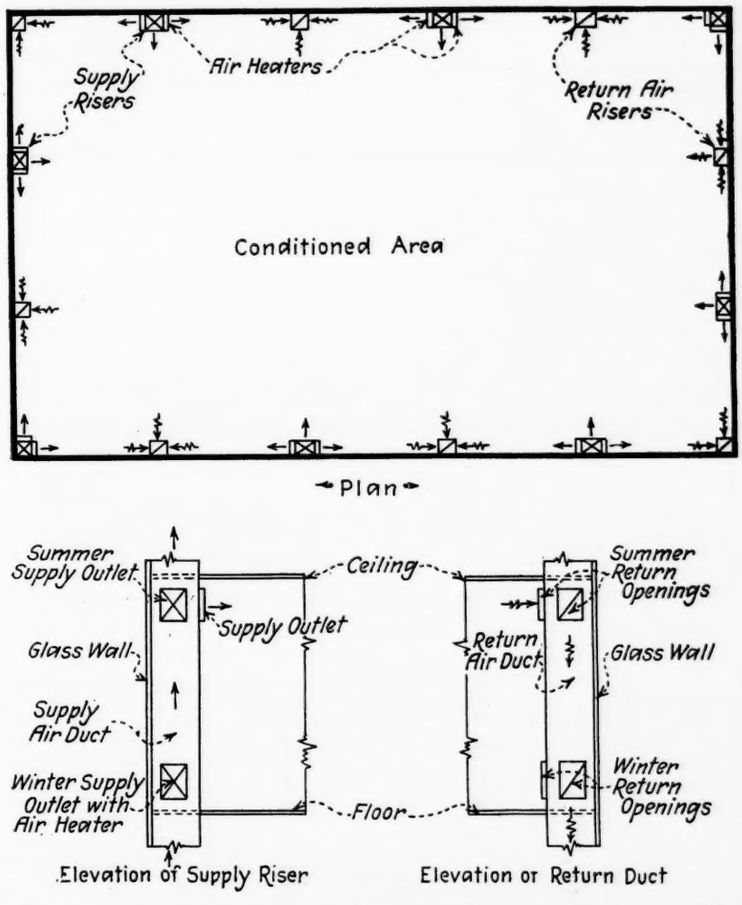


Fig. 1. Typical Arrangement of Air Conditioning System in Building of Glass Construction when all Heat Losses Occur at the Walls

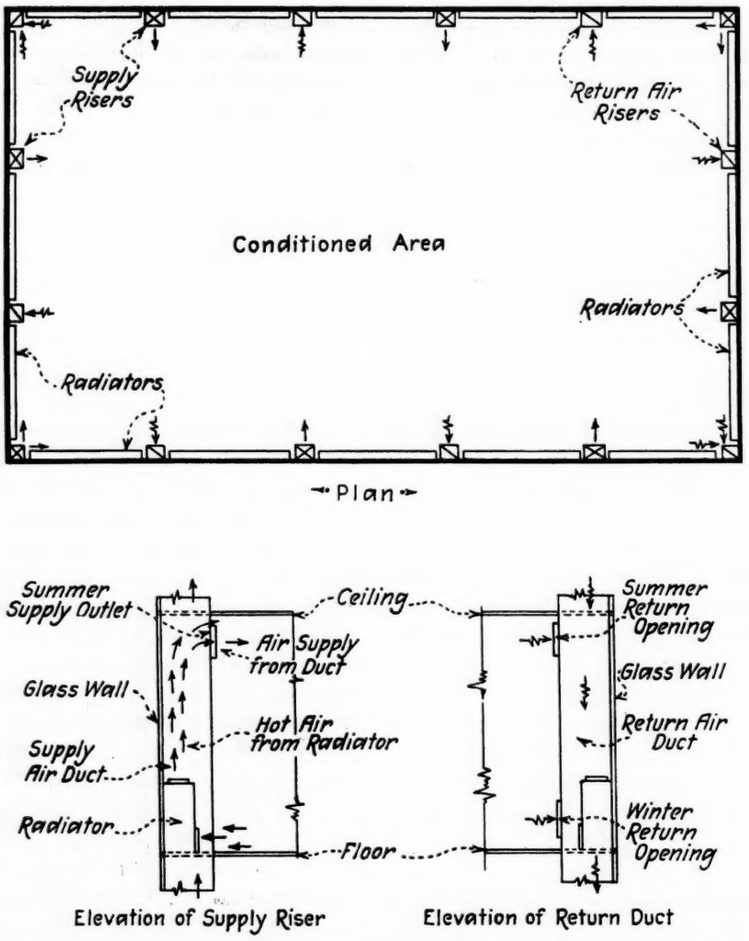


Fig. 2. Another Arrangement for Building of Glass Construction Permitting Shut-Down of Circulating Fan During Non-Working Hours

and high temperature air across the glass surfaces. With horizontal distributing ducts this would be almost impossible, but with vertical branches it is fairly simple. This factor, then, automatically decides that vertical distributing ducts will care for the building to best advantage throughout the year.

To illustrate the method, Fig. 1 shows the arrangement discussed above. In summer the air is supplied and returned at the ceiling, and in winter the air discharged into the room is supplied along the ceiling at room temperature or less, while that discharged parallel to the wall is supplied at the floor through air heaters, where, being hot, it will tend to rise and form a film of hot air over the surface of the glass. The winter return connections are designed to remove the cold air from the floor.

The other solution of the moisture condensation problem is a nicer one from an engineering standpoint and has several features that make it desirable. The idea is to use a central conditioning system to control and maintain the humidity, supplemented by a system of direct radiators under thermostatic control to maintain the proper temperature. Here again vertical distribution of the air is desirable, and the same supply method used for summer as described above.

In winter, however, there would be no air discharged parallel to the walls, all being directed toward the center of the room at room temperature or less. Radiators would take care of all heat losses and would induce a continuous current of hot air over the glass surfaces, as shown in Fig. 2. The radiators should be of the concealed type and should be the length of a bay, it being assumed that the supply and return risers occur at the building columns. This offers a better solution of the main problem and permits the shutting off of the circulating fan during the non-working hours and saving the power for driving it.

The brick building and its problems can now be considered. The question of air distribution is not quite as complex as the one met in the glass building and there is more room for flexibility of design. Due to the more normal distribution of the heat load in summer there is no

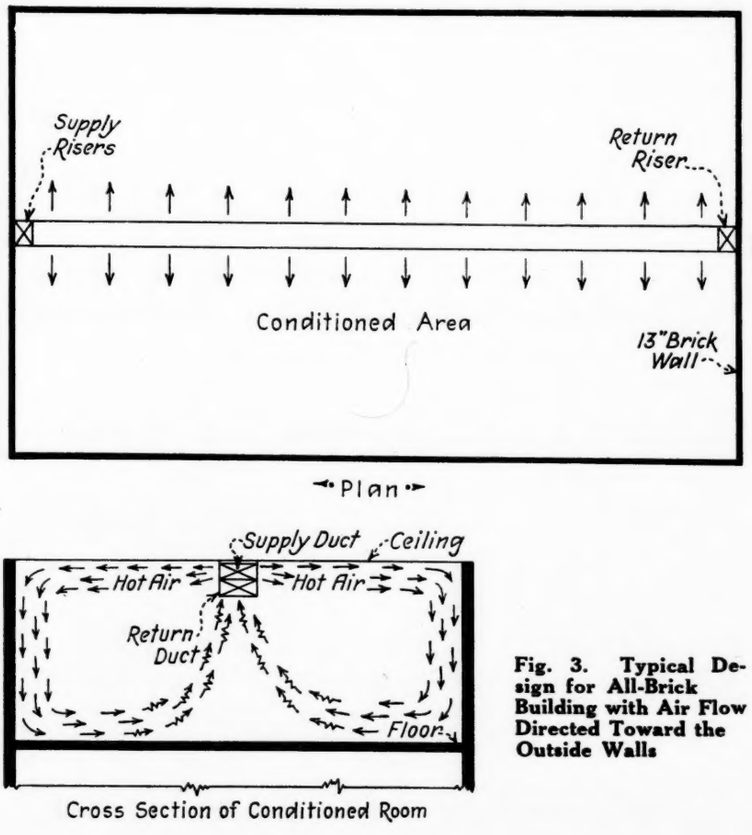


Fig. 3. Typical Design for All-Brick Building with Air Flow Directed Toward the Outside Walls

distinct advantage in using either vertical or horizontal air distributing ducts, for while the maximum heat load in both buildings is about the same, in the brick structure the major heat producer, the lights, are evenly spaced over the entire area to be treated. Thus it makes little difference whether the air is introduced at the walls, discharging into the room, or supplied from a longitudinal duct directing the air toward the walls, unless the question of control accuracy is taken into consideration. As mentioned before, horizontal distribution makes automatic control easier, everything else being equal.

In winter, the air can be supplied by either method mentioned in the last paragraph, but it becomes necessary, when vertical supply risers are used, to direct air, as in the glass building, at a low temperature toward the room's center, and high temperature air along the walls. With horizontal ducts it will be possible to take advantage of the natural tendency of the air to stratify and direct the air at a temperature above that in the room toward the walls, as shown in Fig. 3.

If properly introduced, the air will be supplied and directed toward the walls, and, as it passes over the lights, picking up still more heat, it will drift along the ceiling and down the walls at a temperature sufficiently high to compensate for the transmission losses. By constantly gaining heat as it passes over the ceiling the supplied air will remain at or near ceiling level as a blanket, due to its lower weight, and will then be cooled down at the wall, traveling back across the floor at the desired temperature.

The problem of moisture condensation does not enter in the brick building calculations as the wall surfaces will not be so low as to precipitate moisture from the air. This eliminates consideration of the direct radiation system as it would not have any obvious advantages over a complete blast heating system, and would add to the initial cost of the installation, against which the saving in fan motor power during non-working hours would be the only saving. As the interest and depreciation on the investment for radiators would about balance the cost of the power saved, it would be logical to omit them.

The problem of drafts in the brick building differs from that of the glass building in that most of the trouble would be encountered during the winter rather than summer, and as winter drafts are mostly above head level, the draft problem is minimized.

For either design the air conditioning system should be of the central station type with independent temperature controls for the various floors and rooms. The central apparatus, consisting in large part of a fan, dehumidifier, refrigeration plant, and central air heaters should be located as centrally, in relation to the conditioned areas, as possible. In a multiple-story building it will probably be found that for flexibility of operation and control the lower floors can be supplied by a unit, or units, located in a basement and the upper floor by a similar number of stations in an attic, or top floor.

Provision must be made for exhausting all the supplied air for the building during such times as the temperature of the outside air permits the conditioning system to operate without the use of artificial refrigeration. This can be done by equipping the building with exhaust stacks in which automatic pressure-relief dampers are installed. The moisture content of the air can be controlled from central apparatus.

The above discussion of the problems encountered by the air conditioning engineer are interesting from the standpoint of design, as the way of distributing the air will influence the general building construction to some extent; as for instance, with the vertical method, it would be possible to fit the supply and return risers in with the columns, or even use hollow steel columns as ducts, while with the horizontal distribution, arrangement of floor space and placing of equipment will affect or be affected by the air mains, etc.

From a psychological point of view the two designs will have quite opposite and definite effects upon the occupants as far as the building construction is concerned, but in relation to air conditioning the effect on the workers in the brick building will be much more drastic, for there will be no glass surfaces to give even an illusion of the old-fashioned windows. This, of course, will be a transient consideration, as we grow accustomed to almost any condition to which we are exposed.

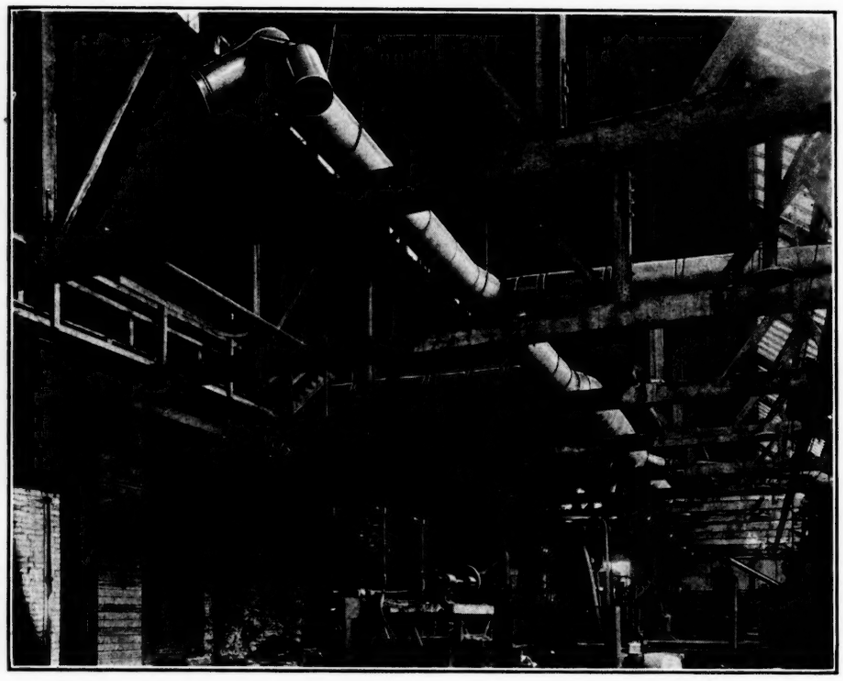
The question of comparing the cost of heating, ventilating, lighting and air conditioning the two buildings becomes too involved to offer any definite figures. Some general statements can be made which will give a basis of comparison. To begin with, the heating system for the glass building must be at least four times as large as that for the brick to take care of the maximum demand, which we will assume to be for twelve hours of the day.

For a full day with a minimum outdoor temperature of 0° F. the total steam consumption for heating the glass building would be about 18 times as much as that for the brick, but the cost of lighting the brick building would be about 20 times as much as that for the glass.

Without definite figures as to the cost of electricity and steam, the expense of lighting and heating the brick building for one day during 0° weather should be about as much as that of heating the glass building, assuming a cost of forty cents per 1000 lb. of steam, and a cost of 1.1 cents per kw. hr. This makes the heating of the glass building for a season much less expensive, as the cost of lighting is a constant factor with the brick construction for every day in the year, and a great deal of the heat generated by the lights will be wasted on days when the outdoor temperature is above 0° F.

During the summer the cost of cooling the brick building will be higher for the season, as the heat given off by the lights is constant, while the large heat factors due to transmission and radiant heat from the sun in the glass building disappear at times and reach a maximum only a limited number of days a season.

This seems to make the glass building a slightly better investment if all other factors are the same, the heating and air conditioning equipment necessitating a larger initial expenditure, but the cost of maintenance being much lower. The equipment for the brick building has the advantage of requiring a smaller initial investment, and being somewhat simpler to operate.



Modern Fan-Duct System Recently Installed in Building Built in 1782

Duct Design *for* Fan-Steam Systems

by **WALTER F. HEIBEL**

A CENTRAL fan system is worthy of serious consideration where humidity and close temperature regulation are important factors. Too, air changing devices can be readily incorporated. It is often possible to place a fan and heater in an equipment room, or in a space that can serve no other useful purpose, close to the boiler room where the steam piping can be simplified and where the operation of the fan and heater can be under the close observation of the operator.

The duct system is of importance, and the first step in its design is to make a rough layout of the general scheme to be used. It is essential that the air be brought to the proper points for distribution, in order that the heat may reach all points of exposure and circulate freely without interference from equipment within the building. Each outlet in the distributing ducts should have a definite reason for its position, designed to deliver to the room a definite number of heat units to replace a definite amount of transmission and leakage loss, or in the case of straight ventilation, to furnish the correct amount of air where it will do the greatest good.

Cognizance must be taken of the steel and other structural features of the building in order that the layout when finally completed can be installed without major changes. Where possible, the distribution ducts are placed at the ceiling or within the roof truss construction, with broaches at frequent intervals leading from the main duct to positions that insure the best heating and ventilating effects. Often outlets, taken directly from the main distribution duct to permit the air to be blown directly across the heated or ventilated space, are all that is needed for proper distribution. For heating, it is considered good practice to distribute the air along the outer walls, or areas of maximum exposure; but such distribution is not always possible and a study must be made of each individual problem in order to obtain best results.

The author points out that the friction chart so widely used in the design of ducts must be used with care when the cross section of the duct is not circular. Ducts of rectangular cross section must be converted into round ducts of equal frictional resistance at the same velocity before applying the chart.

Occasionally space conditions do not permit the installation of overhead ducts and they must be located underground. Such ducts should be avoided whenever possible, since the heat losses from underground air conduits are very great, and also because drainage may be a difficult problem. Underground ducts are usually of masonry construction and the leakage of air through their porous walls is excessive. Furthermore, the temperature drop, unless heavy insulation is used, is considerably greater than that met with in overhead ducts. It seems to be the exceptional mechanic who can make a proper joint between the sheet metal riser and the masonry work, and in a system employing a large number of branches the leakage of heated air at such points materially affects the efficiency of the system.

Except in unusually large buildings it is rarely necessary to employ more than a single fan and heating unit to take care of the entire building, but where the building is so

large that the ducts and units involved would become unwieldy and of uneconomical proportions, the building should be studied with a view of determining the most logical locations for the equipment in point of installation, operation, and heat and air distribution.

It is customary to recirculate practically all of the air handled by the fan, and in the average industrial building ventilation does not suffer by so doing. However, certain plants employing processes that vitiate the air, or buildings that are densely populated must have a definite amount of outside air introduced for ventilation. The recirculated air may be drawn into the inlet of the heater by the supply fan directly through openings into the heated space; or, where conditions do not permit this, separate recirculation ducts may be installed. In such cases exhaust fans are sometimes used with proper damper arrangements for exhausting any desired portion of the air to out-of-doors.

Ducts made of sheet metal offer minimum resistance to the flow of air and admit of very little leakage. The ducts should be kept as nearly square in cross section as possible, and all branch ducts leading from the main trunk ducts should be provided with long sweep elbows and deflector plates, in order to assure the proper distribution of air with the least resistance. Outlets from the ducts should be designed to give the best distribution of air with the least possibility of drafts, and should be provided with dampers for regulating the amount of heat or air distributed. Supply outlets can usually be depended upon to give satisfactory distribution if they are of sufficient size to keep the velocity between 300 and 500 ft. per min. through them; but in some industrial buildings with exceptionally high ceilings, it is necessary to design the outlets so that velocities as high as 1000 to 1200 ft. per min. may be maintained. Where metal ducts pass through cold areas, or are in contact with exterior walls, they should be protected by a covering of insulating material. Where the ducts pass through outside or unheated areas, the covering should be of sufficient thickness to prevent an excessive heat loss. Specifications for this work generally require 2 in. of magnesia, or equivalent, with a one-half inch cement coating, in proportions of one-half asbestos and one-half Portland mix. Ducts in contact with exterior walls should be adequately covered with joints sealed to prevent heat loss. The gauges of metal should be of sufficient thickness to insure against vibration, sagging, and distortion, due to inside air pressure. It is recommended that angle iron bracing be installed at frequent intervals along the duct to which the hangers should be attached, thus eliminating the necessity for piercing the ducts for the hanger fasteners.

Design of the recirculation ducts should be similar to that of the supply ducts.

The arrangements for the discharge of air out-of-doors should be of proper design for preventing admission of rain, snow, etc. It is not considered good practice to discharge the air to the outside horizontally, due to the effects of shifting wind, and wherever possible, vertical discharge caps should be used.

System for Ventilation Only

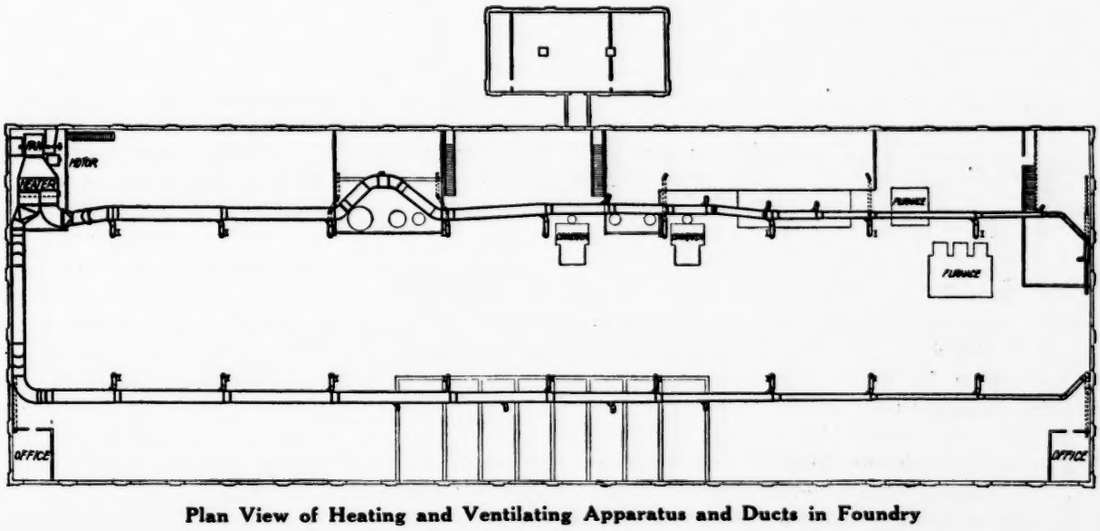
When the system is installed for ventilation only, the necessary heating effect is accomplished by other means—usually direct radiation. In this case the fan duct system supplies the air to the room at approximately room temperature, and in volumes intended to produce a comfortable working condition. This volume may be small in cases of light occupancy, or great in cases of greater occupancy or vitiating processes within the building.

Ventilation requirements fix the volume of air to be delivered to the room. Well designed ducts will insure the placing of each cubic foot of air where it will do the most good. Distribution of the air must be accomplished with a minimum expenditure of horse power, through ducts which encroach as little as possible on the working space, and in no way interfere with other building equipment.

Example: Assume a factory building 100 ft. $\times$ 50 ft. $\times$ 25 ft. high whose use and occupancy require a ventilation factor of 1 cu. ft. of air per min. per sq. ft. of floor area.

Air Required: Total volume, 100 ft. $\times$ 50 ft. $\times$ 1 ft. $=$ 5000 c.f.m.

Heat Required: Total B.t.u. per



Plan View of Heating and Ventilating Apparatus and Ducts in Foundry

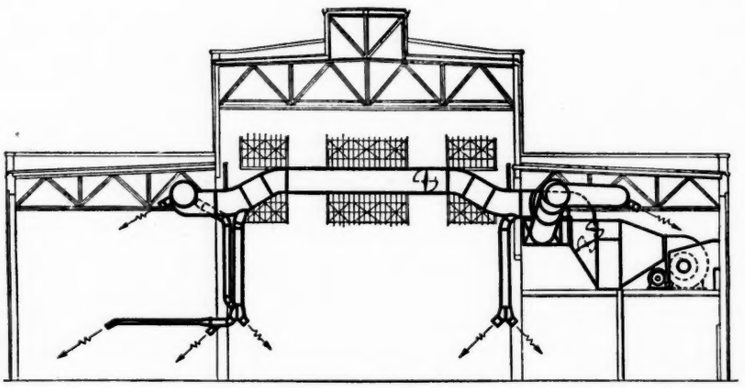
hr. $= v \times C_p \times d \times [(t_r + t_x) - t_o] \times 60$.

where

v = Volume of air in cubic feet per minute.
d = Density of air at temperature of building.
t_1 = Temperature of building.
t_r = Temperature of air leaving heater.
t_o = Outside temperature.
t_x = Loss in temperature in ducts.
C_p = Specific heat at constant pressure = 0.24

assuming $t_r = 60°$, $t_1 = 60°$, $d = 0.075$, $t_o = 0°$, $t_x = 0°$ (no loss of temperature in ducts), then the B.t.u. per hour equals $5000 \times 0.24 \times 0.075 \times 60 \times 60$ equals 324,000 B.t.u. to be added to the air from out-of-doors.

Having determined the volume and temperature rise through the heater, the size of heater may be chosen from the published data of the various manufacturers.



ELEVATION & SECTION

Fan and Heater are Suspended by Structural Steel Work in This Foundry

System for Heating Only

When the system is installed for maintaining a required temperature in a building, all air may be recirculated. The heat then supplied by the air must balance the transmission and infiltration losses, and must be sufficient to maintain the chosen inside temperature after cooling from the initial temperature of the air leaving the supply openings.

In this case, the requisite heat is calculated in the customary manner for transmission and leakage, and for purposes of this example will be assumed as 185,000 B.t.u. per hr.

$$\text{B.t.u.} = v \times \text{Specific Heat} \times d \times [(t_r - t_x) - t_1] \times 60$$

to be furnished by heater.

$$\text{Or, } v = \frac{\text{B.t.u.}}{\text{Specific Heat} \times d \times [(t_r - t_x) - t_1] \times 60}$$

Assuming that t_r is 120°, t_x is 5° and t_1 is 60°, then

$$v = \frac{185{,}000}{0.24 \times 0.075 \times 55 \times 60}$$

or v equals 3115 c.f.m.

The heater requirements will be $3115 \times 0.24 \times 0.075 \times 60 \times 60$ or 202,000 B.t.u. per hr.

In case the heater room is included in the heat loss calculations, all the heat lost through the ducts will heat the building so that t_x will be zero. In such a case the volume to be supplied will be

$$\frac{185{,}000}{0.24 \times 0.075 \times 60 \times 60} = 2855$$

c.f.m.

The size of the heater may be determined from the published data in the manufacturer's catalogs from the above volume and temperature rise.

System for Heating and Ventilating

When the system is installed as the only heating medium, and at the same time to provide outside air for ventilating purposes, there are two conditions that must be met, combining the effects as outlined above. First there is the volume required for ventilation, and second, the heat required to raise the temperature of this volume from outside temperature to room temperature $(t_1 - t_o)$. This volume fixes the amount of air available for heating also.

The heat then becomes:

B.t.u. $= v \times 0.24 \times 0.075 \times (t_1 - t_o)$ (for ventilation)

B.t.u. $= v \times 0.24 \times 0.075 \times [(t_r - t_x) - t_1]$ (for heating)

Therefore the total heat which must be supplied by the heater is equal to the sum of these two quantities.

Where a portion of the air only is drawn in from the outside and the remainder is recirculated, the resulting temperature of the mixture entering the heater is determined by the formula:

$$t = \frac{v_o \times d_o\,(t_o + 460) + v_1 \times d_1\,(t_1 + 460)}{v_o d_o + v_1 d_1} - 460$$

where

v_o = Volume of outside air needed for ventilation.
d_o = Density of outside air.
v_1 = Volume of air recirculated from building.
d_1 = Density of recirculated air.

Pneumatic Exhaust Systems

In designing a system for the removal of dust, sawdust, textile lint and other materials, the sizes of fans and ducts are determined by the amount of material that must be removed and the specific weights which affect the density of the conveying air.

Velocities necessary in the ducts to hold the material in suspension and keep it moving depend on the specific weights of the materials, and vary from 2500 ft. per min. to 6000 ft. per min. State codes and local ordinances should be consulted when designing such a system in order to determine the local requirements.

A definite suction should be maintained at each outlet, and the air quantities calculated to flow into each opening. In this connection it

is necessary to introduce a coefficient of influx, depending upon the shape of the nozzle or hood. A loss in suction head of about 25% is customarily used. In other words, the suction pressure at the inlet opening will be only about 75% of the suction in the duct at the inlet opening.

From the fundamental law of falling bodies, $v = \sqrt{2gH}$, where v is the velocity in feet per second, g is the acceleration due to gravity,

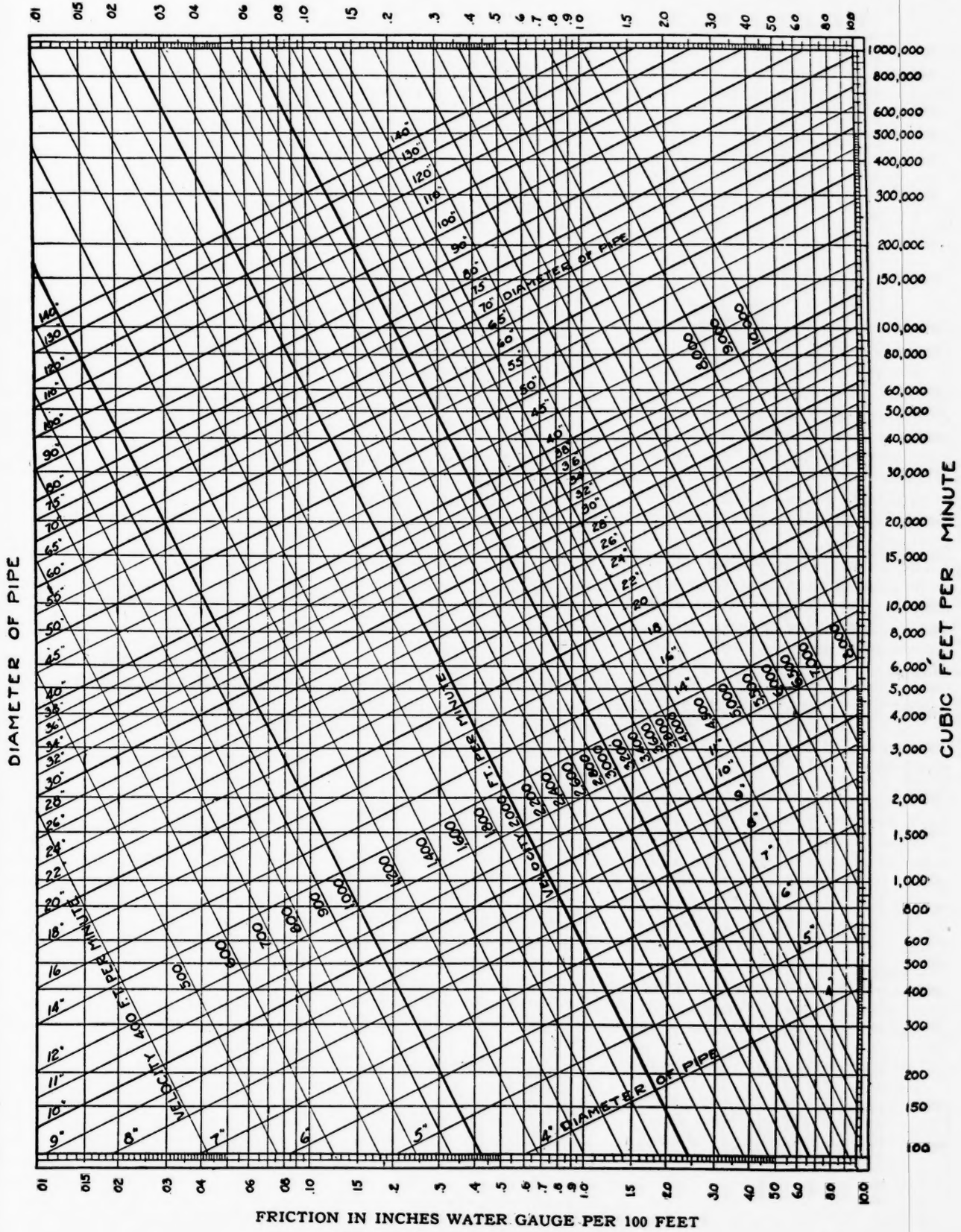

DIAMETER OF PIPE
CUBIC FEET PER MINUTE
FRICTION IN INCHES WATER GAUGE PER 100 FEET
VELOCITY 400 FEET PER MINUTE
VELOCITY 1200 FEET PER MINUTE
4" DIAMETER OF PIPE

Chart for Calculating Friction in Ducts

h is the height in feet for falling object.

Assume in the above formula that H is the head in feet of water.

Then $H = \frac{vp \times 62.3}{w \times 12}$ where vp is the velocity head in inches of water, w is the air density. 62.3 is the weight of 1 cu. ft. of water at 60° F.

Then $v = \sqrt{2g \frac{vp \times 62.3}{w \times 12}}$

Velocity in feet per minute, $V = 60v$

Or, $V = 60 \sqrt{2g \frac{vp \times 62.3}{w \times 12}}$

$$V = 1096.2 \sqrt{\frac{vp}{w}}$$

And for 60° air, w = 0.075 so that $V = 4000\sqrt{vp}$

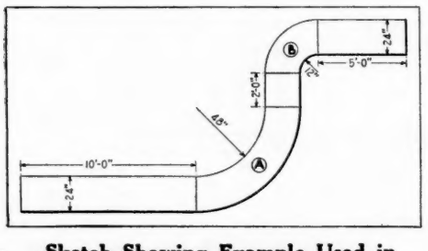
From this formula, it will be seen that the velocity in the duct can be determined when the suction at the nozzle or hood is established. This suction varies from 2 to 6 in. water gauge.

Therefore, volume of air equals velocity × area of duct at point of suction reading.

The gauges of metal for pneumatic exhaust ducts must be heavier than is the case with ventilating systems, and the following schedule can be used safely for ordinary exhaust work.

Diameter of Duct, Inches	Gauge, Pipe, U. S. Standard	Gauge, Elbows U. S. Standard
4	18	16
5 and 6	16	14
8 and larger	14–16	12–14

When the system of conveying ducts has been marked in roughly as noted above, mark opposite each outlet the quantity of air it is to supply to the building. The size of each outlet is determined by dividing the volume of air thus obtained by the velocity through the outlet. The proper velocity for various locations of the outlets is given in the table, and also depends upon length of "blow" and types of diffuser.



Sketch Showing Example Used in Figuring Elbows

Velocities for Various Locations of Outlets

Height of Outlet from Floor, Feet	Velocity, Feet per Minute	Temperature Entering Room, Deg. F.
8	350	70 to 120
30	1000 to 1200	70 to 130
20	1000	70 to 140
12	500	70 to 140

The following table shows the velocities in feet per minute for various parts of the system:

Through face area of system	400 to 700
Through free areas of heater	800 to 1200
Through horizontal supply ducts	1000 to 1800
Through vertical branch ducts	600 to 800
Through registers	350 to 1200

The friction chart has been widely used in calculating the friction in a duct system. It is essential that it be used correctly. The figures given therein represent friction offered by the flow of air in inches water gauge per 100 ft. of straight round galvanized iron pipe.

Ducts of rectangular cross section must be converted into round ducts of equal frictional resistance at the same velocities, before applying the chart. In transforming rectangular ducts to round ducts, the following equation should be used:

$$D = \frac{4AB}{2(A + B)}$$

where

D is the equivalent diameter of round pipe, A is the width of rectangular duct, B is the depth of rectangular duct.

Example: It is required to find the frictional resistance of 5000 c.f.m. of air through 28 ft. of 24 in. diameter straight galvanized iron pipe. Reading on the right hand side of the chart, 5000 c.f.m. of air, we follow horizontally to the intersection of this line with the diagonal line representing the diameter of pipe which in our case is 24 in. Reading vertically down, from this intersection, we find that the friction in inches water gauge per 100 ft. is 0.199.

Therefore the net resistance for 28 ft. equals

$$\frac{28 \times 0.199}{100} = 0.0557 \text{ in.}$$

Now assume that the duct is rectangular in cross section and is to convey 5000 c.f.m. of air.

Assuming the size of duct is 36 in. × 14 in., the velocity of air equals

$$5000 \div \frac{36 \times 14}{144} = 1430 \text{ ft. per min.}$$

Converting the 36 in. × 14 in. duct into a round duct by applying the above equation:

$$D = \frac{4 \times 36 \times 14}{2(36 + 14)} = 20.16 \text{ in.}$$

By again referring to the friction chart we find that the resistance through 100 ft. of 20.16 in. duct at a velocity of 1430 ft. per min. equals 0.1586 in. water gauge, and for

$$28 \text{ ft.} = \frac{28 \times 0.1586}{100} = 0.0444 \text{ in.}$$

This chart is often incorrectly used, and it is important to note that the resistance through the equivalent 20.16 in. diameter is equal to the resistance through the 36 in. x 14 in. rectangular duct at the same velocity and that no cognizance should be taken of the volume that the chart indicates would be delivered by the 20.16 in. equivalent round duct.

The chart below shows the frictional resistance of 90° elbows for various throat radii.

R	¼	½	1	2	3	4
D	70	30	10	4.5	4.8	5.25

R = Radius of throat of elbow, expressed in diameters of pipe (or dimension of rectangular duct in the plane of curvature).

D = Number of diameters of straight pipe offering equivalent resistance to the flow of air.

Example: A 24 in. x 9 in. rectangular duct makes two 90° turns as shown in the accompanying sketch.

$$\text{Ratio for elbow A} = \frac{48}{24} = 2,$$

and from the chart above the friction equivalent equals 4.5 diameters.

$$\text{Ratio for elbow B} = \frac{12}{24} = 0.5,$$

and from the chart, the friction equivalent equals 30, hence the total equivalent length of duct equals:

Straight duct, 10+2+5	= 17 ft.
Elbow, A, 4.5 × 2 ft.	= 9.0 ft.
Elbow B, 30 × 2 ft.	= 60.0 ft.
Total	= 86.0 ft.

For ventilating and heating work, the following gauges are considered good practice.

Diameter of Duct, or Largest Dimension of Rectangular Ducts, In.	Gauge U. S. Standard
Up to 24	24
25 to 36	22
37 to 48	20
49 and above	18

On ducts 4 ft. in diameter, and larger, angle iron stiffeners should be used at about 4 ft. intervals to prevent vibration.

State Laws Relating to Heating and Ventilating Industrial Buildings

Illustrations Courtesy of Department of Labor, Bureau of Industrial Hygiene, State of New York

THE following abstracts from State laws are those which are applicable to exhaust ventilation for the removal of dust, odors, gases, fumes, excessive humidity, etc., in industrial buildings. In this connection industrial buildings are considered as including factories, mills, and workshops, but not including garages, stores, or mines. Any laws which relate to the heating or general ventilation of such buildings are included, where such laws exist.

The laws are divided into two groups. 1. Those which relate to the heating and ventilating of industrial buildings in general, and 2. Those which relate to the heating and ventilating of buildings devoted to a specific industry.

Where there are no laws listed it is because, so far as we have been able to determine, no definite laws exist covering this work at the time of going to press. However, engineers are advised to get in touch with the department handling factory inspection in the state in which a project is contemplated in order that revisions or changes will not pass unnoticed. For example, Indiana advises that a new code relating to the ventilation of industrial buildings will be off the press probably before January 1, 1931.

These laws cover only those of States and not ordinances adopted by municipalities, towns or villages.

While the laws given on these pages are complete so far as general laws go, many States have special laws relating to specific industries and processes. Abstracts of these laws will appear in an early issue of Heating and Ventilating.

California

Sec. 4 of the Laws on Sanitation and Ventilation of Factories and Workshops, issued by the Bureau of Labor Statistics, states essentially that:

In any factory, workshop, or other establishment where a work or process is carried on by which dust filaments, or injurious gases are produced or generated, that are liable to be inhaled by persons employed therein, the person, firm, or corporation by whose authority the process is carried on shall provide in the factory exhaust fans or blowers with pipes and hoods extending therefrom to each machine by which dust, filaments, or injurious gases are produced or generated, the system to be properly fitted and adjusted, and of such power and dimensions to effectually prevent the dust or injurious gases from escaping into the atmosphere of the room or rooms of said factory, workshop or other establishment where persons are employed.

I. W. C. Order No. 4, covering laundry and manufacturing industries, issued by the Division of Industrial Welfare of the Department of Industrial Relations, states: (a) The ventilation of each workroom shall be adequate. (b) If dust, gases, fumes, vapors, fibers or other impurities are generated or released in the course of the process carried on in the workroom, in quantities tending to injure the health of those employed therein, such suction or other special devices as may be necessary to remove at the point of origin, or render harmless, such impurities, shall be installed and operated. (c) The nature of the process permitting, there shall be maintained in each workroom during the months from October to April inclusive, a minimum temperature of 58° F. and, the weather permitting, a maximum temperature of 72° F. If, owing to the nature of the process, excessive heat be created in the workroom, such special devices as may be required to reduce such excessive heat shall be installed and operated.

Ventilation and Heating of Toilet Rooms. Toilet rooms shall be adequately ventilated, and the ventilation shall be only to the outside of the building. Every toilet room and watercloset compartment shall be kept heated during working hours to not less than 50° F. at all times.

Connecticut

Labor Laws of the State of Connecticut, July, 1929, include an Order to Remove Excessive Dust, essentially as follows: Every employer whose business requires the operation or use of any emery, tripoli, rouge, corundum, stone, carborundum or other abrasive, polishing or buffing wheel, in the manufacture of articles of metal or iridium, or whose business includes any process which generates an excessive amount of dust, shall install and maintain in connection therewith such devices as may be considered necessary to remove from the atmosphere any dust created by such process.

Heating of Leased Buildings. Sec. 1. When any building or part thereof is occupied as a place of business, either mercantile or otherwise, a temperature of less than 68° F. in such building or part thereof shall, for the purpose of this act be deemed injurious to the health of the occupants thereof.

Delaware

Laws of the Labor Commission of this State, which relate to employment of children and females, state in the Sanitary Law for Female Employees that "in every establishment named in this act in which females are employed or permitted to work, there shall be provided not less than 250 cu. ft. of air space for each person in every workroom. All workrooms shall be adequately heated and ventilated."

District of Columbia

The Building Code of the District of Columbia, adopted by the commissioners of the District, effective July 1, 1930, under Sec. 5, Ventilation Requirements, Part 4, Workshops and Workrooms, states:

All rooms used as workshops, factories, kitchens and manufacturing plants, shall be provided with windows or ventilating skylights with area of openings not less than 1/10 the floor area of each room so occupied or used. All such windows shall open upon yards or courts with an area as required by the zoning regulations.

Workrooms of 2,000 sq. ft. or more in area, in addition to window ventilation, shall be provided with ventilating ducts connected to individual ventilators or

grouped together in the attic space into one ventilator. The total area of the ducts shall provide for 6 changes of air per hr.

Illinois

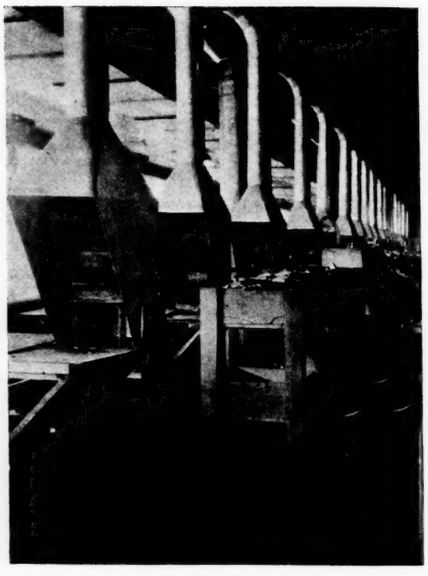
The Blower Law of the State of Illinois enforced by the Department of Labor, Division of Factory Inspection, states essentially that:

All persons, companies or corporations operating any factory or workshop, where emery wheels or emery belts of any description are used, either solid emery, leather, leather-covered, felt, canvas, linen, paper, cotton, or wheels or belts rolled or coated with emery or corundum, or cotton wheels used as buffs, shall provide the same with blowers beside or under such wheels or belts in such manner as to protect the employes from the particles of the dust produced, provided, that grinding machines upon which water is used at the point of grinding contact and shops having only one man on this work shall be exempt from the provisions of this act.

Such wheels as mentioned above shall be fitted with a sheet or cast iron hood or hopper of such form and so applied to such wheel or wheels that the dust or refuse will be carried off by the current of air into a suction pipe attached to same hood or hopper.

Such wheels 6 in. or less in diameter shall be provided with a 3-in. suction pipe; wheels 6 in. to 24 in. in diameter with 4-in. suction pipe; wheels from 24 in. to 36 in. in diameter with 5-in. suction pipe; and all wheels larger in diameter than those stated above shall be provided each with a suction pipe, not less than 6 in. in diameter. The suction pipe from each wheel, so specified, must be full size to the main trunk suction pipe, and the main suction pipe to which smaller pipes are attached, shall, in its diameter and capacity, be equal to the combined area of such smaller pipes attached to the same, and the discharge pipe from the exhaust fan, connected with such suction pipe or pipes, shall be as large or larger than the suction pipe.

The blowers shall run at a speed such as will produce a velocity of air in the discharge pipes of at least 9000 ft. per min. to an equivalent suction or pressure of air equal to raising a column of water not less than 5 in. in a U-shape tube. All branch pipes must enter the main trunk pipe at an angle of 45° or less, the main suction or trunk pipe shall be below the emery or buffing wheels, and as close to the same as possible, and to be either upon the floor or beneath the floor on which the machines are placed to which such wheels are attached. All bends, turns or elbows in such pipes must be made with easy, smooth surfaces, having a radius in the throat of not less than two diameters of the pipe on which they are connected.



Battery of Soldering Iron Stoves with Hoods to Remove Products of Combustion and Material which may be Burned Off Irons

The Health, Safety and Comfort Law states essentially:

In every factory or workshop where one or more persons are employed, adequate measures shall be taken for securing and maintaining a reasonable, and as far as possible, equable temperature, consistent with the reasonable requirement of the manufacturing process. No unnecessary humidity shall be permitted.

In every room or apartment of any factory, mill or workshop, where one or more persons are employed, at least 500 cu. ft. of air space shall be provided for each person employed, and fresh air shall be supplied in such a manner as not to create injurious drafts, nor cause the temperature of any such room or apartment to fall materially below the average temperature maintained: Provided, where lights are used which do not consume oxygen, 250 cu. ft. of air space shall be deemed sufficient.

All rooms or apartments of any factory, mercantile establishment, mill or workshop, having at least 2000 cu. ft. of air space for each person employed in each room and having outside windows and doors whose area is at least one-eighth of the total floor area, shall not be required to have artificial means of ventilation; but all such rooms or apartments shall be properly aired before beginning work for the day and during the meal hours. All such rooms or apartments having less than 2000 cu. ft. of air space, but more than 500 cu. ft. of air space, for each person employed therein, and which have outside windows, and doors whose areas are at least one-eighth of the floor area, shall be provided with artificial means of ventilation, which shall be in operation when the outside temperature requires the windows to be kept closed, and which shall supply during each working hour at least 1500 cu. ft. of fresh air for each and every person employed therein.

All such rooms having less than 500 cu. ft. of air space for each person employed, all rooms having no outside windows or doors, and all rooms having less than 2000 cu. ft. of air space for each person employed, and in which the outside window and door area is less than one-eighth of the floor area, shall be provided with artificial means of ventilation, which will supply during each working hour throughout the year, at least 1800 cu. ft. of fresh air for each person employed: Provided, that the provisions of the preceding portions of this section shall not apply to storage rooms or vaults, and that the preceding portions of this section shall not apply to those rooms in which manufacturing processes are carried on which from their peculiar nature would be materially interfered with by the provisions of this section. No part of the fresh air supply required by this section shall be taken from any cellar or basement.

The following terms of this section shall be interpreted to mean: The air space available for each person is the total interior volume of a room, expressed in cubic feet, without any deductions for machinery contained therein, divided by the average number of persons employed therein.

Outside windows and doors are those connecting directly with the outside air; the window and door area is the total area of the windows and doors of all outside openings; and the floor area is the total area of each room.

All factories or workshops shall be kept free from gas or effluvia arising from any sewer, drain, privy or other nuisance on the premises. All poisonous or noxious fumes or gases arising from any process, and all dust of a character injurious to the health of the employes created in the course of a manufacturing process shall be removed, as far as practicable, by either ventilating or exhaust devices.

The Basement Blower Law states:

Sec. 1. The manufacture, repairing or altering of any metals, wares or merchandise which may produce or generate poisonous or noxious fumes or dusts in harmful quantities, such as metal polishing, grinding, plating and dipping of metals in acid solutions or dips, are hereby declared to be especially dangerous to the health of the employes so engaged. Such manufacture, repairing or altering of any metals or merchandise in such processes and places of employment shall be conducted in rooms lying wholly above the surface of the ground.

Indiana

At the time of going to press, Chapter 20, covering Power, Heating and Ventilation of the Rules and Regulations covering all public buildings, is in the hands of the printers.

Iowa

Health and Safety Appliance Laws of Iowa, Secs. 1489 and 1490, state essentially:

All firms operating any factory or workshop where emery wheels or emery belts of any description, or tumbling barrels used for tumbling or polishing castings, are used, shall provide the same with blowers and pipes of sufficient capacity, placed in such a manner as to protect the employes from the particles of dust produced or caused thereby, and to carry away the particles of dust. Grinding machines upon which water is used at the point of grinding contact, and small emery wheels which are used temporarily for tool grinding, are not included within the provisions of this section.

Any factory, workshop, printshop or other place where molten metal or other material which gives off deleterious gases or fumes is kept or used shall be equipped with pipes or flues so arranged as to give easy escape to such gases or fumes into the open air, or provided with other adequate ventilators.

Kansas

Industrial Welfare Orders of the Commission of Labor and Industry, 1930, state that: Heat and ventilation shall be employed at all times to keep the workers comfortable and well supplied with fresh air.

Maine

Sec. 12 of the Labor Laws of Maine states that: If the Commissioner as State Factory Inspector, or any authorized agent of the Department of Labor and Industry, shall find upon inspection that the heating or ventilation of any shop or factory is such as to be injurious to the health of the employes, the inspector shall notify the owner of the factory to make the alterations or additions deemed necessary for the safety and protection of the employes.

Massachusetts

Labor Law Bulletin No. 9 of the Department of Labor and Industries, Division of Industrial Safety, includes the following:

Sec. 107. The water used for humidifying purposes by any person operating a factory or workshop shall be of such a degree of purity as not to give rise to any impure or foul odors, and shall be so used as not to be injurious to the health of persons employed in such factories or workshops.

Sec. 108. In every weaving and spinning department in a textile factory wherein water is introduced for humidifying purposes there shall be provided, maintained and kept in correct working order, for the purpose of recording and regulating the humidity of the atmosphere and the temperature, at least one set of standardized wet and dry bulb thermometers, and, if required by an inspector, two sets of such thermometers, and the following regulations shall be observed in their use:

The thermometers shall be placed as directed or sanctioned by an inspector, and be plainly visible to the workers. The occupier or manager or person for the time being in charge of the weaving or spinning department shall read the thermometers thrice in the day, namely, between seven and eight o'clock in the forenoon, between ten and eleven o'clock in the forenoon and between three and four o'clock, except in rooms lighted by gas, and then between four and five o'clock, in the afternoon of every day when persons are employed in any weaving or spinning department, and he shall record the readings of each thermometer in such department at each of the said times upon a form provided therefor, which, together with the regulations relating thereto, shall be furnished by the Department of Labor and Industries. The records of the readings shall not be destroyed until the inspector in whose district the factory is situated has examined them and given his consent to their destruction.

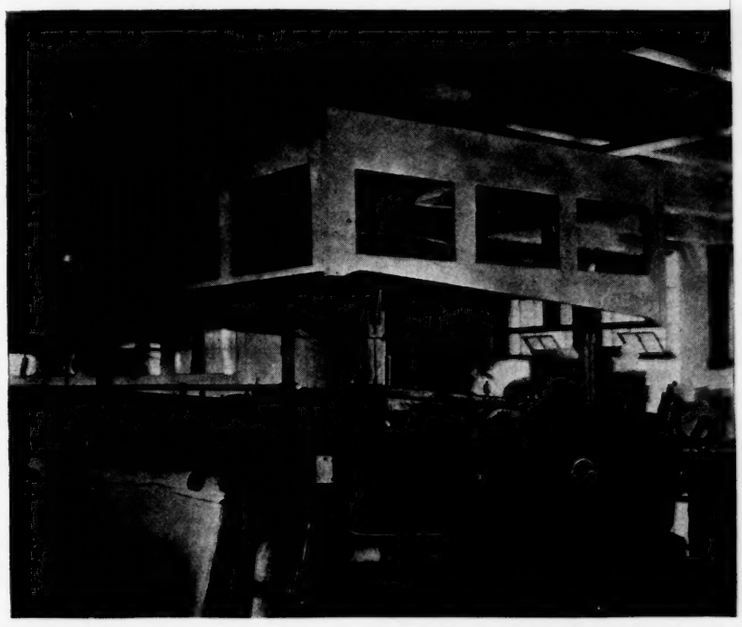
Sec. 109. The preceding section shall not apply to textile factories equipped with such a number and type of standardized self-registering hygrometers, or psychrometers, or such a hygrometric system as the department approves, or using the sling hygrometer frequently to determine the actual moisture and temperature of the weaving or spinning department; provided, that the manner of using all such instruments or such system is approved by the industrial health inspector in whose district the factory is situated, and that the records of the readings from said instruments or system are not destroyed without the knowledge and consent of such inspector.

Sec. 110. No owner, occupier, manager or person for the time being in charge of a textile factory shall permit the relative humidity in a weaving or spinning department in the textile factory under his control to exceed the following limits. (See Bulletin No. 9).

Sec. 111. Water used for humidifying purposes in a textile factory shall be taken either from a public supply of drinking water, or from some other source of pure water, or from a supply of water which is sufficiently free from impurities so as not to be dangerous to the health of employes when used for humidifying purposes; and all ducts for the introduction or distribution of humidified air shall be kept clean.

Sec. 113. Every factory shall be well ventilated and kept clean and free from unsanitary conditions.

Sec. 117. A factory where five or more persons and a workshop where five or more women or children are employed shall, while work is carried on therein, be so ventilated that the air shall not become so impure as to be injurious to



Large Exhaust Hood Over Flatwork Ironer Showing Entire Device Raised

the health of the persons employed therein. A factory or workshop where more than one person is employed shall be so ventilated that all gases, vapors, dust or other impurities injurious to health, generated in the course of the manufacturing process, shall so far as practicable be rendered harmless.

Sec. 118. If, in such a factory, any process is carried on by which dust is caused which may be inhaled to an injurious extent by the persons employed therein, and it appears to an inspector that such inhalation would be substantially diminished without unreasonable expense by the use of mechanical means, such mechanical means shall be provided.

Sec. 119. Any factory or workshop where emery wheels or belts or buffing wheels or belts injurious to the health of employes are used shall provide such wheels and belts with a mechanical exhaust system.

Sec. 120. Every such wheel shall be fitted with a hood or hopper of such form and so placed that the particles or dust produced by the operation of the wheel shall fall into such hood or hopper by centrifugal force; and the fans or blowers shall be of such size and shall be run at such speed as will produce a volume and velocity of air in the suction and discharge pipes sufficient to convey all particles or dust from the hood or hopper through the suction pipes and so outside of the building or to a receptacle as aforesaid. The hoods or hoppers shall be so constructed and the suction pipes and connections shall be suitable and efficacious and such as shall be approved by the department.

Sec. 121. The two preceding sections shall not apply to grinding machines upon which water is used at the point of grinding contact nor to solid emery wheels used in sawmills or in planing mills or in other woodworking establishments, nor to any emery wheel 6 in. or less in diameter used in establishments where the principal business is not emery wheel grinding.

Michigan

The Labor Laws, published by the Department of Labor and Industry, in Sec. 5343-8337, covering workrooms, state essentially that:

Not less than 250 cu. ft. of air space shall be allowed for each person employed, and all workrooms shall be provided with sufficient heat and ventilation as may be prescribed by the chief factory inspector.

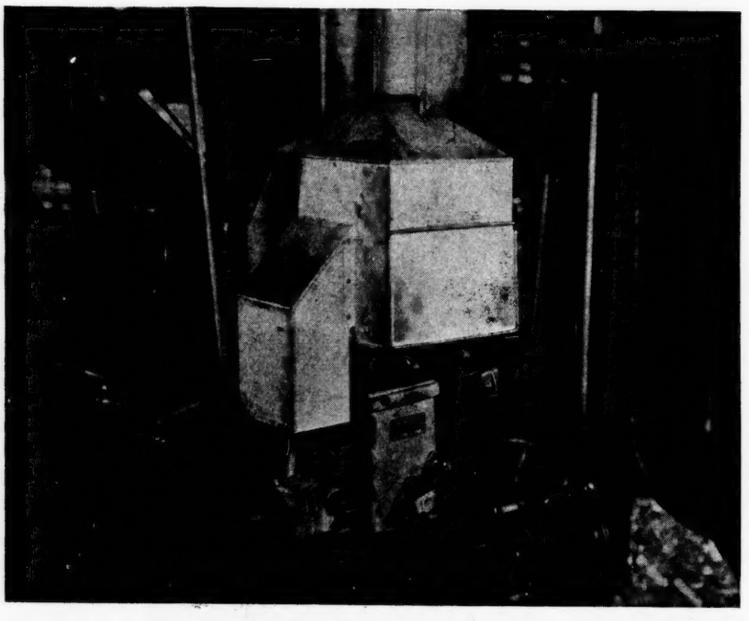
Sec. 5344-8338. Factory inspectors shall have power to order the installation of proper and adequate ventilating devices in manufacturing establishments, where by reason of the nature of the work such inspectors may consider such devices necessary for the preservation of the health or safety of the persons employed; such devices to supply fresh air in equal quantities to the exhausted air at room temperature not to exceed six changes per hour or less as conditions may require in such establishment.

Sec. 5348-8342. All firms operating any factory or workshop where wheels or emery belts are in general use, either leather, leather covered, felt, canvas, paper, cotton, or wheels or belts rolled or coated with emery or corundum, or cotton wheels used as buffs, shall provide the same with fans or blowers or similar apparatus to carry the dust arising from, or thrown off by the wheels or belts. Grinding machines upon which water is used at the point of grinding contact shall be exempt from the conditions of this act and this act shall not apply to solid emery wheels used in sawmills or plaining mills or other woodworking establishments.

Sec. 5349-8343. Each wheel shall be fitted with a sheet or cast iron hood or hopper of such form and so applied that the dust or refuse therefrom will be carried off by the current of air into a suction pipe.

Sec. 5350-8344. Each wheel 6 in. or less in diameter shall be provided with a 3-in. suction pipe, wheels 6 in. to 24 in. in diameter with 4-in. suction pipes, wheels from 24 in. to 36 in. in diameter with 5-in. suction pipes, and all wheels larger in diameter than those stated above shall be provided each with a suction pipe not less than 6 in. in diameter. The suction pipe from each wheel so specified must be full size to the main trunk suction pipe, and the said main suction pipe to which smaller pipes are attached shall, in its diameter and capacity, be equal to the combined areas of such smaller pipes attached to the same, and the discharge pipe from the exhaust fan connected with such suction pipe or pipes shall be as large or larger than the suction pipe.

Sec. 5351-8345. Fans or blowers to be connected with such pipe or pipes shall be run at such rate of speed as will produce a velocity of air in such suction or discharge pipes of at least 9000 ft. per min. or an equivalent suction or pressure of air equal to raising a column of water not less than 5 in. high in a U-shaped tube. All branch pipes must enter the main trunk pipe at an angle of 45° or less. All bends, turns or elbows in such pipes must be made with easy, smooth surfaces having a radius in the throat of not less than 2 in. diameter, of the pipe on which they are connected.

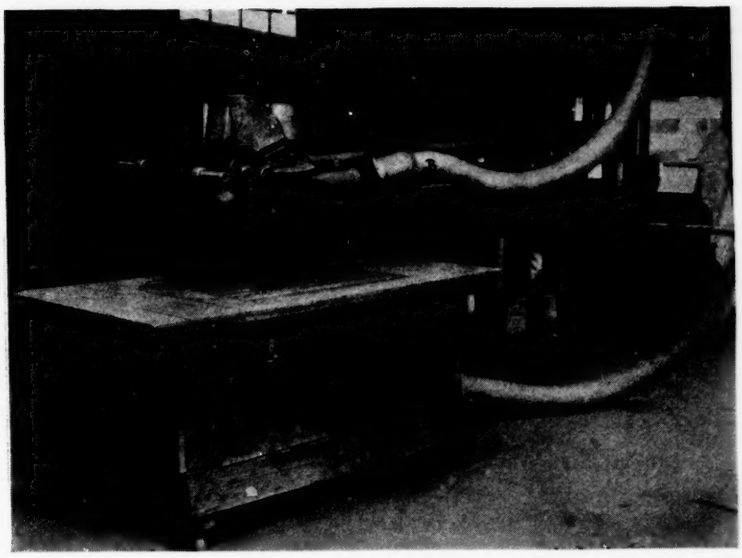


Detail of Exhaust Hood Over Metal Melting Pots of Monomelt Feeds on Linotype Machines

Minnesota

The revised labor laws of Minnesota, published by the Industrial Commission of Minnesota, give essentially the following:

Sec. 4174. In every place of employment the employer shall provide, in each workroom, proper and sufficient means of ventilation, and shall maintain proper and sufficient ventilation. If excessive smoke, steam, gas, fumes, vapors, dust or other impurities are created or generated by the manufacturing process in sufficient quantities to obstruct the vision, or to be irritating, obnoxious, or injurious to the health or safety of the employes, the room shall be ventilated to remove them or render them harmless, so far as is practicable. If in the opinion of the Commissioner of Labor



Swing Frame Grinder Surfacing Sheets of Metal. A Shows Perforated Cover of Hopper, B Shows Flexible Hose Adjustment Through which Dust is Drawn Horizontally While Operating the Wheel

it is deemed necessary, he may order the installation of exhaust fans and other mechanical means of a proper construction to effectively remove from the point of origin such smoke, steam, gases, etc.

Sec. 4175. No more employes shall be required or permitted to work in a room in any place of employment than will allow to each of such employes not less than 400 cu. ft. of air space, unless by a written permit of the Commissioner of Labor such amount of air space for each employe may temporarily be reduced to not less than 250 cu. ft. of air space. Provided, that no such permit shall be issued for a room in which smoke, gas, fumes, dust or vapors are generated or in which there are fires consuming oxygen.

Sec. 4176. In every place of employment that workrooms shall, so far as the nature of the industry will permit, be properly heated during cold weather. In every place of employment where excessive heat be created in any of the workrooms by the nature of the process carried on therein it shall be the duty of the employer to provide mechanical means that are necessary to protect from the heat and to carry off, so far as practicable, such excessive heat and to cool off such workrooms. It is unlawful to establish any process which creates excessive heat in any workroom the ceiling of which is less than 8 ft. from the floor.

Use of salamanders or other heaters that discharge smoke or gas into a workroom in which workers are employed is prohibited.

Mississippi

Laws administered under the direction of the Department of Factory Inspection, from the Code of 1906, etc., state that: Sufficient ventilation shall be provided and maintained in all factories and workshops where excessive heat, steam, gases, vapors, dust or other impurities injurious to the health are generated. The room shall be provided with ventilation and humidity to render them harmless so far as is practicable.

Missouri

The Labor, Industrial and Statistical Laws of Missouri, issued by the Department of Labor and Industrial Inspection, 1927, provide in Sec. 6796 for the following:

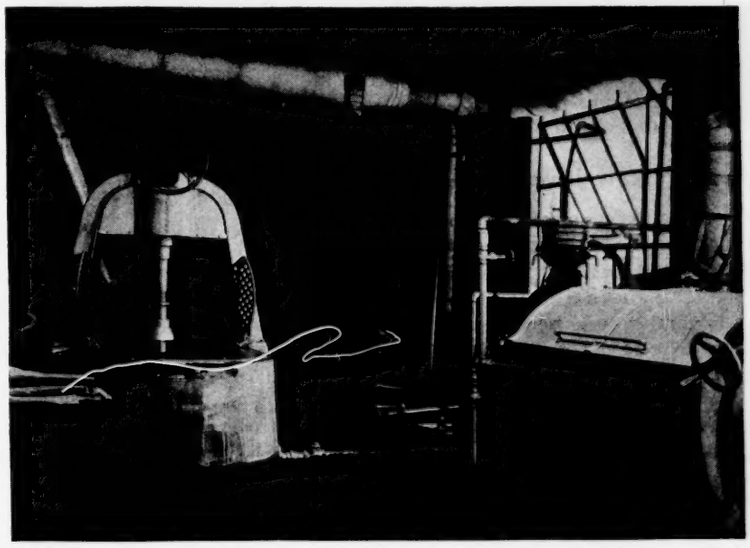
All manufacturing, mechanical, and other establishments in this state shall be so ventilated as to render harmless all impurities, as near as may be.

And in Sec. 6798: Every person, firm or corporation using any polishing wheel or machine which generates dust, smoke or poisonous gases, shall provide such wheels or machines with a hood, which shall be connected with a blower or suction fan to carry off such dust, smoke and gases.

In all establishments in this State where any process is carried on by which dust or smoke is generated, the industrial inspector and his assistants and deputies shall have the power and the authority to order that a fan or some other contrivance be put in to prevent the inhalation of such dust or smoke by employes.

Sec. 6818. Articles considered dangerous to health.—The carrying on of any process or manufacture, or labor in this State in which antimony, arsenic, brass, copper, lead, mercury, phosphorus, zinc, their alloys or salts or any poisonous chemicals, minerals, acids, fumes, vapors, gases, or other substances, are generated or used, employed or handled by the employes in harmful quantities, or under harmful conditions, or come in contact with in a harmful way, are declared to be especially dangerous to the health of the employes.

Sec. 6826. Prevention of dust.—When any flues or other apparatus are used in any such process, manufacture or labor, referred to in Sec. 6818, and when such flues or other apparatus are being cleaned or emptied, the employer shall in every case provide and maintain an adequate and efficient means or device, such as canvas bags, or by dampening the dust, or some other efficient method for catching and collecting the dust and preventing it from unreasonably fouling or polluting the air in which the employes are obliged to work. Such parts of the work or process as are especially dangerous to the employes on account of poisonous fumes, dusts and gases, shall, where practicable, be carried on



System Used in Connection with Electrical Interlock on Hydro-Extractor

in separate rooms and under cover of some suitable and efficient device to remove the danger to the health of such employes as far as may be reasonably consistent with the manufacturing process.

Sec. 6839. Every factory in which three or more persons are employed, and in which children, young persons or women, three or more in number, are employed, shall be so ventilated that the air shall not become so exhausted as to be injurious to the health of the persons employed and shall also be so ventilated as to render harmless, so far as is practicable, all the gases, vapors, dust or other impurities generated in the course of the manufacturing process.

Sec. 6840. If, in a factory or workshop included in Sec. 6839, any process is carried on by which dust is generated and inhaled to an injurious extent by the employes, and it appears to the industrial inspector, or his assistant, that such inhalation could be to a great extent prevented by the use of mechanical means, and that it could be provided without excessive expense, the inspector may direct mechanical means of a proper construction to be provided.

Nebraska

The Safety Codes of the Department of Labor of Nebraska state in Rule 46a relating to dry cleaning and dyeing establishments that "heating of building must be by steam or hot water only."

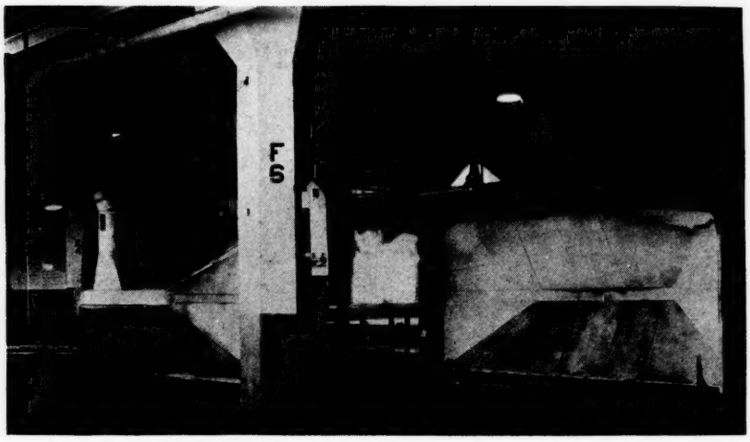
Rule 56 states essentially that every workroom in which people are regularly employed, and in which any machinery or apparatus is operated generating steam, vapors, excessive heat, fumes or dust that are injurious to the health of the workers, shall be ventilated by an approved method of natural or mechanical ventilation, or both, as may be necessary to maintain proper ventilation, temperature and humidity and to reduce excessive heat at all times during working hours.

The mechanical means of ventilation, local or general, shall consist essentially of an exhaust system.

New Jersey

In the Sanitary and Engineering Industrial Standards, published by the Department of Labor, revised September 15, 1927, Rules 8 and 9 state that plans in duplicate of new installations, or alterations to old installations, must be filed with the Bureau of Hygiene and Sanitation, with fees depending upon the cost of the apparatus to be installed.

The Standards contain specifications for exhaust systems, in which are covered the material, gauge of metal, riveting, soldering, laps, elbows, collars, dust separators, joints and other construction details.



Exhaust System for Automobile Paint Shop Using an Air Brush with Compressed Air

New York

Sec. 299 of the New York State Labor Law, states essentially that:

Every workroom in a factory shall be provided with proper and sufficient means of ventilation, natural, mechanical or both, and there shall be maintained therein proper and sufficient ventilation and proper degrees of temperature and humidity at all times during the working hours. If, owing to the nature of the manufacturing process carried on, excessive heat be created, there shall be provided special means or appliances as may be required to reduce the excessive heat.

All machinery creating dust or impurities shall be equipped with proper hoods and pipes connected to an exhaust fan of sufficient capacity and power to remove such dust or impurities; such fan shall be kept running constantly while the machinery is in use. If in case of woodworking machinery the board decides that such apparatus is unnecessary for the health and welfare of the employes, it may adopt rules excepting such machinery from the operation of this subdivision.

If dust, gases, fumes, vapors, fibers or other impurities are generated or released in the course of the business carried on in quantities tending to injure health, suction devices shall be provided which shall remove such impurities at their point of origin where practicable, by means of proper hoods connected to conduits and exhaust fans.

The board shall make rules for and fix standards of ventilation, temperature and humidity in factories and shall prescribe the special means, if any, required for removing impurities or for reducing excessive heat.

No greater number of persons shall be employed in any room of a factory between 6 a.m. and 6 p.m. than will allow such person so employed 250 cu. ft. of air space nor, unless by written permit of the commissioner, than will allow 400 cu. ft. of air space for each person employed between 6 p.m. and 6 a.m.

Ohio

The Ohio State Building Code, Bulletin of Division of Factory and Building Inspection, No. 109, November, 1929, states essentially in Sec. 20 that:

Factories where employes are performing hard labor shall be heated to 40° in zero weather. Factories where employes are performing light labor shall be heated to 70° in zero weather.

Not less than 400 cu. ft. of air space shall be provided for each occupant of each room in workshops and factories. Where impossible to obtain the required cubical content or where the nature of the occupancy will not permit natural light and ventilation, a ventilating system shall be installed which shall supply not less than 1 cu. ft. of air per min. for each 2 sq. ft. of floor area.

The system to be installed where ventilation is required shall be a standard ventilating stove, unit ventilator, gravity or mechanical furnace, gravity or mechanical indirect steam or hot water or split steam or hot water system. Floor registers will not be permitted.

The same bulletin states that before entering into contract for any public building in the state of Ohio, drawings and specifications shall be submitted in duplicate to the Division of Factory and Building Inspection, Department of Industrial Relations, and among other things the heating and ventilating system shall be indicated. Drawings or specifications need not be submitted for one-story buildings less than 800 sq. ft. in area, etc.

Oklahoma

Bulletin No. 7-A of the Bureau of Factory Inspection, Department of Labor,

1928, states in Sec. 4, Chapter 125 (Session Laws of Oklahoma, 1911):

There shall be sufficient means of ventilation provided in each workroom of every manufacturing or mercantile establishment, laundry, renovating works, bakery or printing office within this State, etc.

Oregon

Sanitary Code, Order No. 22 of the Industrial Welfare Commission, July 3, 1916, orders that the ventilation of each room shall be adequate, and there shall be sufficient provisions for preventing excessive humidity, and an amount of cubic air space necessary to health must be allowed for each employe. The factory Inspection Law of the same State, Sec. 6739, administered by the State Labor Commissioner, states:

Every factory, mill or workshop .... shall be provided in each workroom with good and sufficient ventilation and be so ventilated as to render harmless, so far as practicable, all gases, vapors, dust or other impurities, generated in the course of the manufacturing process. If any process is carried on in any enclosed room by which dust is generated and inhaled to an injurious extent by the persons employed, mechanical means shall be provided and maintained for carrying off or receiving and collecting such dust.

Pennsylvania

Laws administered by the Department of Labor and Industry, in Special Bulletin No. 5, dated 1930, contain essentially the following:

Sec. 2. The manufacture of white lead, red lead, litharge, sugar of lead, arsenate of lead, lead chromate, lead sulphate, lead nitrate, or fluosilicate is declared to be especially dangerous to the health of the employes who are exposed to lead dusts, fumes, or solutions.

Sec. 3. Every employer shall provide the following means for the protection of employes in the above processes, as follows:

(a) The employer shall provide workrooms, adequately ventilated, and so arranged that there is a continuous and sufficient change of air; such rooms to be fully separated by partition walls from departments in which the process is of non-dusty character, and such rooms shall be provided with a floor permitting an easy removal of dust by wet methods or vacuum cleaning, and all such floors shall be so cleaned daily.

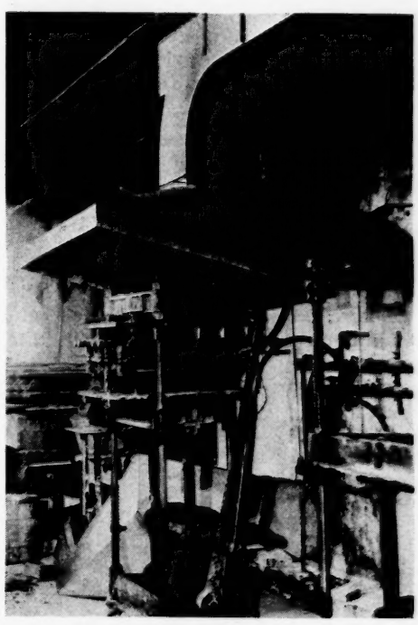
Every work or process referred to in Sec. 2, including the corroding or oxidizing of lead, and the crushing, mixing, sifting, grinding and packing of all lead salts or other compounds referred to in Sec. 2, shall be so conducted, and such devices provided, as to protect the employe from contact with lead dust or fumes. Every kettle, vessel, receptacle, or furnace in which lead, in any form referred to in Sec. 2, is being melted or treated, and any place where the contents of such equipment are discharged, shall be provided with a hood and exhaust system; all vessels or containers in which dry lead in any chemical form or combination referred to in Sec. 2, is being conveyed from one place to another within the factory, shall be equipped, at the places where the same are filled or discharged, with hoods having connection with an efficient air exhaust, and all machinery or other receptacles into which corrosions are at the time being emptied, shall be connected with an efficient dust collecting system; such system to be regulated by mechanical means, either through a cloth dust-collector, having an area of not less than one-half square foot of cloth to every cubic foot of air passing through it per minute, the dust-collector to be placed in a separate room.

Rhode Island

The law administered by the Office of Factory Inspectors simply states that buildings shall be properly heated and ventilated.

Tennessee

Labor Laws of Tennessee, issued by the Department of Labor, Division of Factory Inspection, dated June 1, 1925, state essentially that every factory where work or process is carried on by which dust, filaments, or injurious gases are produced or generated that are liable to be inhaled by employes, the firm shall provide exhaust systems. Provided, however, that if natural ventilation sufficient to exclude the harmful elements above enumerated be provided, the requirement of this section shall have been complied with by the firm.



Forty-eight Inch Square Hood Used with Doll Baking Machines for the Removal of Smoke and Fumes

Not less than 250 cu. ft. of air space shall be provided for each employe or operative at work in a room between the hours of 6 a.m. and 6 p.m. and not less than 400 cu. ft. of air space for each person so employed between the hours of 6 p.m. and 6 a.m.

No person shall hire, employ or contract with another to manufacture any article in any room, unless the room shall be well ventilated and contain at least 500 cu. ft. of air space for every person working therein.

Texas

Laws of Texas Relating to Labor, issued by the Department of Labor, 1930, Art. 1573, R. C. S., 1925, provide essentially for the following:

In every factory, mill, workshop, mercantile establishment, laundry, or other establishment, adequate measures shall be taken for securing and maintaining a reasonable, and as far as possible, an equable temperature consistent with a reasonable requirement of the manufacturing process. No unnecessary humidity which would jeopardize the health of employes shall be permitted. In every such building sufficient air space shall be provided for every employe, and which is sufficient for their health and welfare.

Art. 5174 relating to odors and dust, provides that: All factories, mills, workshops, mercantile establishments, laundries and other establishments shall be kept free from gas or effluvia arising from any sewer, drain, privy or other nuisance on the premises; all poisonous or noxious gases arising from any process, and all dust is injurious to the health of persons employed, created in the process of manufacturing within the above named establishments, shall be removed as far as practicable by ventilators, exhaust fans or other adequate devices.

Vermont

The Commissioner of Industries of this State reports that the only statute relating to heating and ventflating of industrial and factory buildings is G.L. 5847. Under this section the commissioner has jurisdiction for inspection purposes to see that heating and ventilation is not in such a condition to injure the health of persons employed therein.

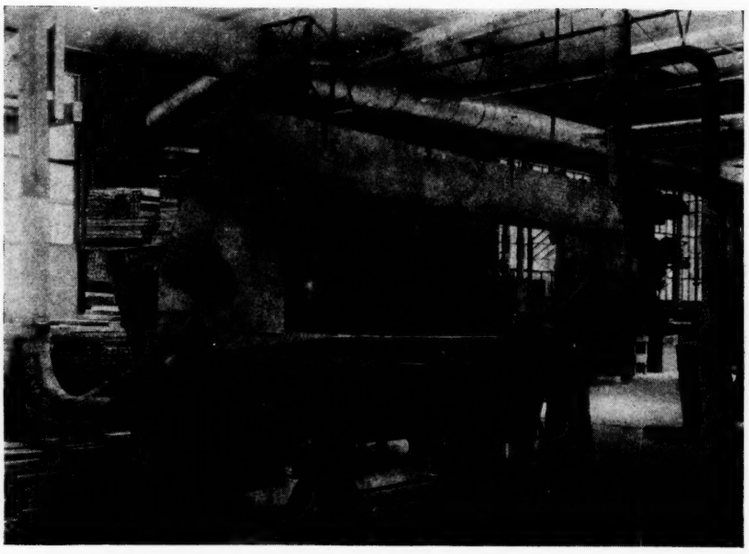
Washington

Sec. 7659 of the Labor Laws (1927) administered by the Department of Labor and Industries states essentially that:

Every factory, mill or workshop where machinery is used .... shall be

provided with good and sufficient ventilation, and shall be so ventilated as to render harmless, so far as practicable, all gases, vapors, dust or other impurities, generated in the course of the manufacturing. If in any factory any process is carried on in an enclosed room, by which dust is generated. mechanical exhaust equipment shall be provided and maintained for carrying off or receiving and collecting such dust.

From the Safety Standards, Standard 46 provides for blower and exhaust systems where the nature of the operations creates a hazard through the accumulation of dust or gases. Standard 48 specifies that where gas or gasoline is used as a source of heat or power, a sufficient circulation of fresh air shall be required. Use of salamanders in enclosed rooms where men are working shall not be permitted unless proper ventilation is provided.



Sand Belt Equipped with Exhaust System to Remove Dust

Wisconsin

The Heating and Ventilation Code is issued by the Industrial Commission of Wisconsin, governing all laws pertaining to this type of work in various buildings. Among other things the bulletin calls for the approval of plans and specifications by the commission for all factories having floor or roof spans greater than 30 ft., or which are more than two stories high, or which are two stories high and are more than 5000 sq. ft. in floor area at the second floor level.

The following orders are from this code worded essentially the same as the code:

Order 5824—Sec. 5. Exhaust systems shall be provided, maintained and operated for all occupied areas, for all machines, vats, tanks, furnaces, forges, salamanders and all equipment and processes in such areas which produce or throw off dust or particles sufficiently light to float in the air, or which emit heat, odors, fumes, spray, gas or smoke, in such quantities as to be irritating or injurious to the health, unless the general ventilation systems keep the air in the breathing zone pure, fresh and clean.

Sec. 6. Where necessary, exhaust systems shall include adequate dust collectors, or air washers, or other machines, contrivances or methods, whereby the discharge from the systems will be prevented from contaminating the breathing zone inside the building.

Order 5853—Places of Employment. This classification shall be understood to include all places of employment not classified elsewhere in this code. Ventilation shall be provided and maintained for all occupied areas of this class: (a) where the available floor space is less than 75 sq ft. per normal occupant; or (b) where heat, smoke, gas, dust, spray, fumes, vapor, steam, foul air or other contamination would otherwise be present in the air in sufficient quantities to obstruct the vision, or to be irritating, or to be injurious to the health, safety or welfare of employes and frequenters; or (c) where industrial poisons are to be used, stored, or handled, or would otherwise be present in the breathing zone.

The air supply provided and maintained for occupied areas of this class shall be not less than an amount sufficient to make up for contamination of air due to the nature of the work being carried on, plus 1 cu. ft. per min. per sq. ft. of floor area; but in no case shall the air supply be less than 30 cu. ft. per min. per normal occupant.

Exhaust systems shall be provided and operated at all sources of air-contamination in occupied areas of this class.

The appendix to the code includes:

Order 2020. Ventilating systems shall be provided at all places of employment where smoke, gas, dust, fumes, vapor, foul air, vitiated air or industrial poisons are used, stored, handled or are present in the air in sufficient quantities to obstruct the vision, or to be irritating, or to be injurious to health, and when there is available less than 1000 cu. ft. of air space per person. Ventilating systems must replace the air twice each hour and supply an additional amount of air to make up for losses or contamination of air or oxygen due to the nature of the work being carried on. All ventilating systems shall furnish as a minimum requirement 1800 cu. ft. of pure, fresh and clean air per person per hour.

Order 2021. Exhaust systems shall be provided for all machines, vats, tanks, furnaces, forges, salamanders and all equipment and processes which create and throw off dust sufficiently light to float in the air or which emit fumes, gas or smoke.

Order 2023. All exhaust systems must be provided with a dust collector, air washer or some machine which will prevent the discharge from contaminating the air.

Order 2025. Conditioning, drying or heating processes shall be carried on in rooms so equipped that there is sufficient motion of the air to prevent the formation and accumulation of poisonous or explosive gases, stagnant or dead air.

• The Fuel Question •

AT present, the question of the proper fuel for use in the heating plants of industrial buildings is very difficult, complicated, and often confusing. Many such plants are expected not only to furnish steam for strictly building heating purposes, but for process and other uses as well. Cost is a prime consideration in most of these plants, and the cost of the fuel itself is only one of the factors which go to make up the total annual cost. Since more than one fuel is practically always locally available, analyses of the total costs with each are usually desirable. In each case, before reliable estimates can be prepared, it is necessary to know or to assume the efficiency with which the fuel under consideration will be used in the particular apparatus provided. If this efficiency of use were for a short period, laboratory test data would yield reliable results. Since the estimate is for annual cost, the efficiency must be on the same basis, and figures are in a rather confused state.

In order to present to our readers information of value in these circumstances, we have asked three prominent engineers, each identified with the use of a particular fuel, to prepare an article setting forth data which in his estimation would be of assistance. As a result, we are pleased to present the three articles which follow.

Mr. Bosler shows a method for estimating the relative value of certain bituminous coals by the use of the proximate analysis and the heating value in the absence of operating test data. The article deals especially with conditions in certain of the eastern states.

Mr. Segeler contributes valuable material intended to improve the confused situation referred to previously—the difficulty of estimating fuel requirements. He refers to the Industrial Degree Day Unit and sets up a logical method of applying this unit to gas-fired installations. He points out that it still is necessary arbitrarily to choose the efficiency of the unit and that the method he proposes is not as yet tried and proved.

In his article on oil-fired installations, Mr. Butler gives data on recently adopted standard specifications for fuel oil and discusses preheating. He illustrates the use of oil in industrial plants, suggests a method of comparing oil with coal and gas, and presents data and results from a field test on an industrial boiler.

Coal

by **LESTER C. BOSLER**

IN making a selection among various types and grades of coal for use in industrial heating plants, the selection must necessarily be made from among those locally available.

The choice is made largely on the basis of fuel cost delivered to the boiler room. This is true because the two items of boiler room labor and fuel costs are the most important in the total heating costs, and the item of labor depends on the method of firing rather than on the type of coal used.

Cost of fuel delivered at the boiler plant is greatly dependent on the cost of transportation. Because of the geographical distribution of the coal fields, the coals economically available for industrial heating plants vary greatly in different sections of the country.

In New England and the states along the Atlantic Seaboard, the available coals include anthracite and low and high volatile bituminous coals. In the Middle West and South, however, the selection must be made between the high and low volatile bituminous coals. In the district beyond the Mississippi River, local coals are widely used.

Due to the concentration of industry along the Atlantic Seaboard, this article will deal with fuel conditions encountered in that territory.

The eastern States, not many years ago, used large quantities of the smaller sizes of anthracite for producing power and heat in industrial boilers of 100 to 200 h.p., and with the prices of bituminous coal and the steam sizes of anthracite equalized, the cleanliness of anthracite caused its greater demand, due to the absence of smoke and dust.

At that time, both bituminous coal and anthracite were hand fired, with the resulting boiler efficiencies not particularly high. A few points one way or the other did not greatly affect the power costs because the delivered price of the fuel was rather low. Very few cities had smoke ordinances because they did not consider the loss to the coal consumer, the health of the people, and depreciation of real estate caused by the emission of smoke.

Today, however, conditions have changed. There have been great advances made in the preparation of anthracite and equally great advances made in the preparation of bituminous coal, resulting in lower ash content and greater uniformity

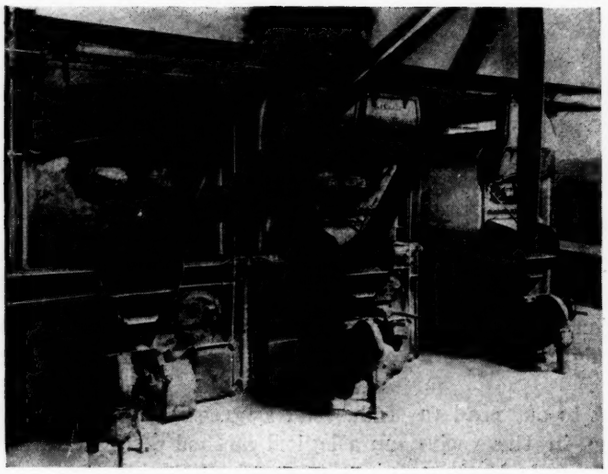


Fig. 1. Underfeed Stokers in Steel Boiler Installation in Printing and Lithographic Plant

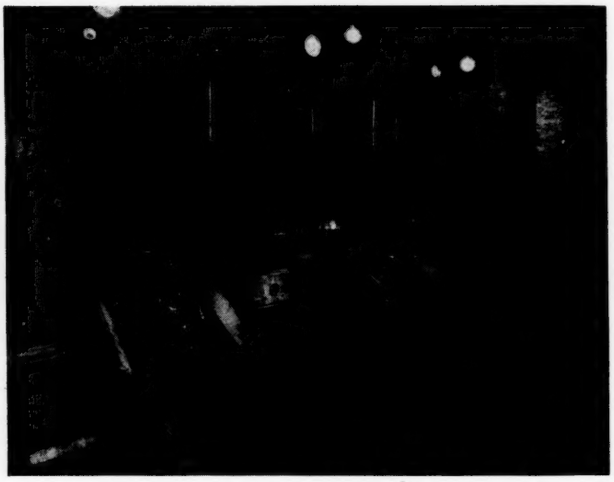


Fig. 2. Screw Type Underfeed Stoker in Burlap Bag Manufacturing Plant

of product. The price of anthracite buckwheat has advanced slightly, while the price of bituminous coal has returned to nearly its old level. At the same time great progress has been made in mechanical methods of firing coal, and today we find more plants mechanically fired than ever before. Mechanical methods of firing made possible a net saving due to the decrease in labor costs and in spite of the increased investment.

Use of these methods usually results in improved evaporative efficiencies and sometimes permits of the effective use of lower priced fuel. An example of the savings resulting from the greater efficiency due to stoker firing and to the reduction in labor costs follows.

These results are from a plant equipped with a 150 h.p. horizontal-return tubular boiler used for heating purposes only. The reduction in costs was brought about by two things:

First, it was necessary, with hand firing, to have a day and night man to operate the boiler. After the stoker was installed, the only attention given during the day was by a man filling the hopper periodically and cleaning the fire once, so that only two hours of his time, per day, could be charged against the boiler plant. Since the stoker was under a pressure control, there was no need for constant attention, so that during the night the operation, except cleaning the fire, was delegated to the night watchman. As a result, two hours of his time were charged to the plant. Second, since the same coal was used during the period when the boiler was hand fired and when it was stoker fired, the reduction in fuel costs was due to the increased efficiency of stoker firing over hand firing. A summary of these charges follows:

	Hand Fired	Stoker Fired
Annual coal consumption, tons	510	430
Delivered cost of fuel to boiler room	$2,550.00	$2,150.00
Labor—2 men, 200 days	2,400.00	400.00
Power		125.00
Interest on investment		150.00
Depreciation		250.00
Total cost	$4,950.00	$3,075.00
Net saving with stoker firing		$1,875.00

Fig. 1 shows one type of underfeed stoker particularly adapted to industrial plant boilers. It is a self-contained unit, can be installed with only minor changes to the setting and, under automatic control, requires very little attention by the operator. Coal is fed to the fire by means of a reciprocating plunger. Fig. 2 shows a stoker of a similar outside design, but using a screw device for coal feed.

Coincident with the development of stokers, progress is being made in adapting pulverized coal-burning equipment to the smaller boilers. Fig. 3 shows a typical installation of a unit pulverizer, supplying a battery of two H.R.T. boilers. It is extremely simple in construction so that ordinary repairs can be made by the regular operating force. The flexibility of this type of equipment makes it adaptable to varying steam demands and very low stand-by losses.

The cost of the unit type of pulverizer is much lower than the bin system, and takes up much less room. It is the generally accepted type installed in the industrial plant.

There has been practically no progress made in the burning of pulverized anthracite in the smaller boilers to utilize the enormous stock of culm at the anthracite mines, which can be had at a very low cost. We will see in the near future great development along this line.

High and Low Volatile Bituminous Coals

Coal contains moisture, volatile matter, fixed carbon, sulphur and ash. Of these, volatile matter and fixed carbon are the heat-producing elements, moisture and ash the inert elements. The ratio of the fixed carbon to the volatile matter is much used to classify coals. In the low volatile coals the volatile matter is under 20%; while the high volatile coals will range from 20% to 45%. The lower the volatile matter content the more nearly bituminous coal approaches anthracite, both in composition and in burning characteristics.

The volatile matter is the gaseous portion of the coal, and the fixed carbon is what generally is considered as the solid portion of the coal. The heat content of the gaseous portion of the coal is greater, pound for pound, than the fixed carbon, but this heat value decreases in general

as the per cent of volatile in the coal increases.

To make this point clear, let us consider the analysis of two coals.

One coal has an analysis of 6.70% ash, 37.06% volatile matter, 56.2% fixed carbon, and a heating value of 13,840 B.t.u. per lb. The other has an analysis of 7.07% ash, 15.33% volatile matter, 77.6% fixed carbon, and a heating value of 14,653 B.t.u. per lb. It will be noted that these two coals contain approximately the same amount of ash, and that the first contains about 37% of volatile, while the second contains about 15% of volatile. In order that the high volatile coal contain its heating value, the volatile material must, itself, have a heating value of about 15,200 B.t.u. per lb. In the same way, the volatile in the low volatile coal must have a heating value of about 21,800 B.t.u. per lb. That is to say, the gases entrained in this low volatile coal are much richer per unit of weight, than are the gases contained in the other coal.

In order that the full heating value of the fuel be available, it is evident that not only must the carbon in the coal be burned but that the energy of the gaseous fuel shall also be released. Since any coal can be efficiently and smokelessly burned, provided the correct amount of air at the necessary temperature can be supplied at the proper time and place, either coal can be effectively used if suitable furnace and air conditions are provided. The firebox of the ordinary heating boiler, especially in low-set boilers originally installed for anthracite, is not especially designed to admit sufficient heated air over the fire to consume all the volatile gases as they are distilled from the green coal. This works to the disadvantage of the high volatile coal, since it is characteristic of these coals to give off large quantities of volatile matter in a short period of time, whereas low volatile coals gasify rather slowly. This gives the secondary or over-grate air more chance to mix with the volatile and results in better combustion.

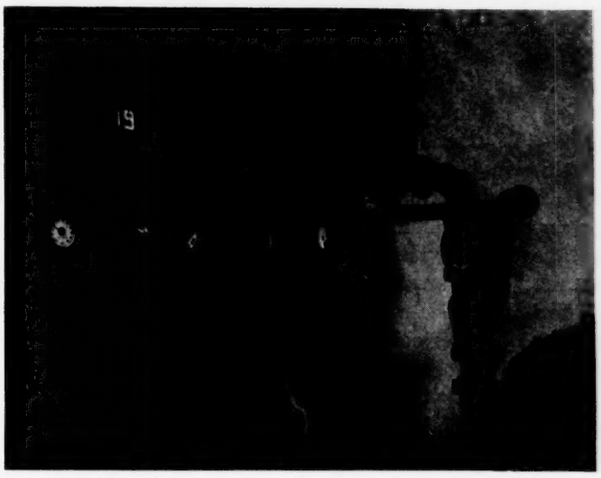


Fig. 3. Unit Pulverizer Supplying a Battery of Two H.R.T. Boilers

It appears that the low volatile coals need about half the secondary air that high volatile coal requires for smokeless combustion. The air leakage through the shutters in the firedoors usually is sufficient to burn the low volatile coals without smoke, whereas it is often necessary partially to open the doors to admit sufficient air for the high volatile coal.

Let us assume, for illustration, that, due to the furnace conditions described above, about two-thirds of the volatile matter in the low volatile coal and about one-half of the volatile in the high volatile coal are completely burned. Assume, also, that the nearly 78% of carbon in the one coal and the 56% in the other are completely burned.

Summing up, then, under these conditions the heat made available from the low volatile coal can be roughly calculated as follows: $2/3 \times 0.1533 \times 21{,}800 + 0.776 \times 14{,}600$ (heating value per pound of carbon) $= 13{,}400$. For the high-volatile coal, the calculation would be: $1/2 \times 0.3706 \times 15{,}200 + 0.562 \times 14{,}600 = 11{,}040$. Consequently, $13{,}400 - 11{,}040 = 2380$, which, divided by 13,400 gives 17.7%. This may be interpreted as indicating that under the assumed condition, about 17% less low volatile coal would be necessary than if the high volatile coal were used. The difference between the reported heat values of the coals by test is: $14{,}653 - 13{,}840 = 810$, or 5.5%. This clearly brings out the

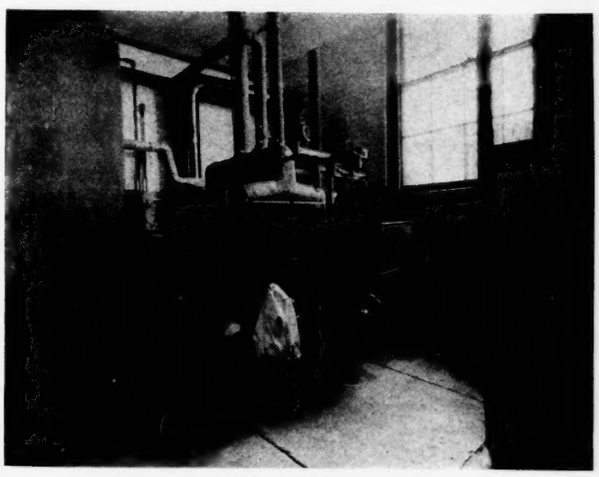


Fig. 4. A Small Anthracite Burning Stoker in a Substation Installation

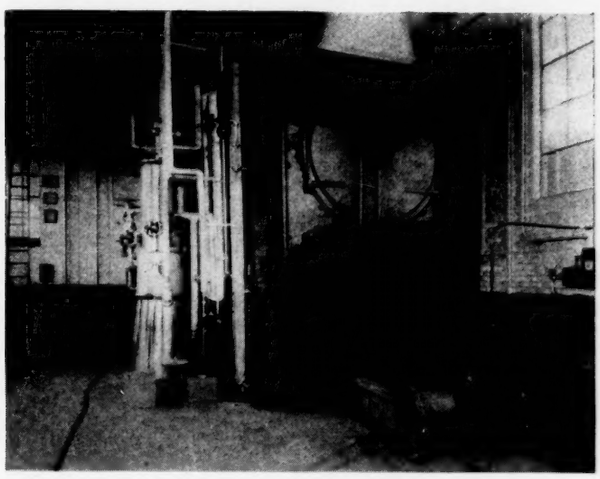


Fig. 5. An Automatic Underfeed Stoker in a 150 Hp. H.R.T. Boiler

point that the heat values resulting from laboratory tests are not an index for selecting coal unless the ability of the boiler furnace completely to burn the gas in the coal is also known. Such data can usually be found only from testing the boiler, but an estimate somewhat similar to the above may yield data helpful in the absence of such tests.

The importance of the ash content must not be overlooked. Ash in coal produces a twofold loss; first, it is wasteful to pay freight on non-combustible material, and, second, the boiler efficiency decreases as the ash content increases, due to fuel bed losses.

A comparison of two low volatile coals of different analyses when burned on hand or stoker-fired equipment would be as follows:

Volatile	15.81%	15.81%
Fixed Carbon	77.27%	74.19%
Ash	6.92%	10.00%
B.t.u. per lb., dry	14,687	14,190

Apparently from the B.t.u. content, the first coal is worth 3.5% more than the second, but the ash content being 3.08% less in the former coal makes it worth 4.4% more instead of 3.5%. With this basis, the relative value of the two coals can be determined, the delivered cost in the boiler room being used in each case and not the price at the mines.

If business conditions prevent any changes in an existing hand-fired boiler plant, it is very important that the proper bituminous coal be selected if the best over-all boiler efficiency is to be realized. Restricted furnace volume causes excessive loss when burning the high volatile coal hand fired. The majority of the older plants in this territory contain low-set boilers, originally installed for burning anthracite, and successfully to burn bituminous coal, this coal should have physical and chemical characteristics similar to the anthracite. The lower the volatile content, the easier it is to burn this coal smokelessly in such plants with the least excess air, both because of the quantity of gas involved and the richness of the hydrocarbons.

GAS

by **C. GEORGE SEGELER**

ALTHOUGH it has been discussed on the pages of this magazine and elsewhere, many times in recent months, it cannot be too strongly reiterated that development in the field of gas is going ahead very rapidly, principally due to the spread of natural gas, and to the introduction of new special rates for gas heating. Natural gas lines have extended into thirty-three States, while only a few years ago the end of the natural gas production had been predicted.

The effect of this on the development of the heating business is most important, because natural gas very often can be purchased at much lower prices than manufactured gas. This does not mean that natural gas is necessarily a cheaper fuel than coal or oil, but it does mean that the availability of natural gas has an important bearing on the future trend of the heating industry, whether for industrial and commercial buildings, or for private dwellings.

Consider, for example, the situation in Dallas, Texas, which in the relatively few years since the intro-

Fig. 1. General View of Industrial Plant Heated by Gas Unit Heaters

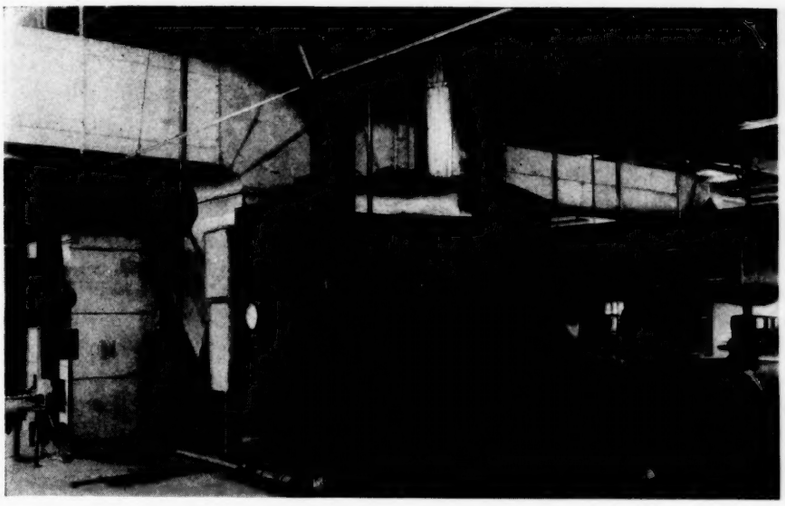


Fig. 2. Gas Heater for Duct Air Heating

duction of natural gas, has become known as a smokeless city, principally because natural gas has supplanted almost all other fuels in that territory. The contribution toward improved living conditions, and the saving by the elimination of smoke and sulphur, cannot be measured. Everyone is familiar with the many reports which have been published on the damage done by these agencies. Why then, continue to suffer such losses and pay a smoke bill when a clean, sulphur-free, automatic fuel like gas is ready to serve the community by eliminating the trouble?

Just for the sake of completeness, it might be well worth while to consider for a moment what natural gas is. Although varying slightly in composition from almost pure methane to mixtures of methane and ethane with some inerts, the B.t.u. value of natural gas is generally in the neighborhood of 1,000 B.t.u. per cu. ft. The lowest B.t.u. of pure natural gas is that served at Denver, where the elevation has reduced the B.t.u. value to 850. The highest B.t.u. value is in the neighborhood of 1,200, but by and large a middle figure of 1,000 is the one most commonly found. This compares with manufactured gas in the neighborhood of 530 B.t.u. per cu. ft.

Just as the development of natural gas has introduced lower priced gas for heating, so too has the widespread adoption of special rates in manufactured gas territory. For example, there is a large plant which was put in service last year using manufactured gas on a new special heating rate in Cranston, Rhode Island. The building is of reinforced concrete, daylight construction, with steel sash, 12 in. thick brick walls between concrete bays and a 4 in. concrete roof with slag surface. The basement floor is 120 ft. x 275 ft., and the second floor, which happens to be the ground floor, has a 15 ft. wide shipping platform along the entire 275 ft. side. This is enclosed by a lean-to roof and Kinnear doors and is heated by large unit heaters merely to a point above freezing. With the exception of a refrigerating room in one corner of the basement, this floor is heated to only 40°. A storage space 64 ft. x 72 ft. is heated to 70°. About two-thirds of the second floor is heated to 50°, and the balance, together with the entire third floor, is heated to 70°.

Two large traveling ovens contribute a good deal of heat to one end of this floor. The fourth floor is divided, the larger portion being heated to 40°, one-third to 70°, and a small amount to 85°. The fifth floor is heated to 40°, although some 1200 sq. ft. are heated to 70°. In addition to the main building, there is a smaller building, an auto repair shop, which is also heated.

The theoretical radiation for the main building figured out to 23,634 sq. ft. of steam, and the smaller building to 884 sq. ft., or a total of 24,518 sq. ft. Steam is supplied by three gas boilers having an American Gas Association rating of 8800 sq. ft. each, or a total of 26,400 sq. ft. In addition to the main heating plant, there are two 20 hp. high-pressure gas boilers for process steam, a gas water heater, and an all-gas cafeteria kitchen.

Practically every bit of gas burned in this building, whether for heating or for process work, is useful in supplying heat to the building. In the heating season 1928-1929, with 5477 degree days, the total gas for all purposes came to 31,359,000 cu. ft., of which about half was used by the boilers. In the season 1929 - 1930, with 5709 degree days, there was a total gas consumption of 31,530,000 cu. ft., of which a little less than half was used by the boilers.

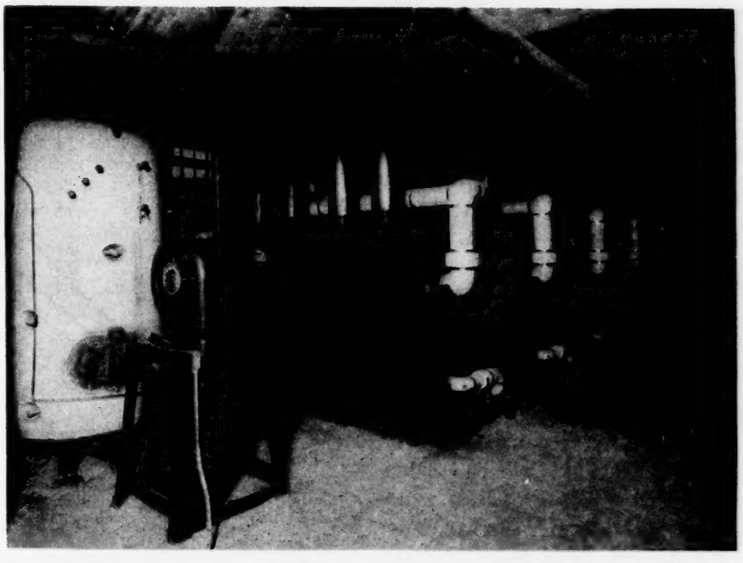


Fig. 3. Five Gas Boilers Supplying 28,000 Sq. Ft. of Direct Radiation. High-Pressure Gas Steam Boiler Shown at the Left

New Heating Methods

In the gas heating field there has been developed an important new heating method. It has already received considerable publicity, but especially for industrial building heating it seems to be destined for very rapid growth. It is the gas unit heater, which differs from its companion steam unit heater in being a completely self-contained heating appliance, and with the exception of electric wiring and the gas pipe, requires no further equipment. The gas unit heater is really a *unit* heater.

Gas piping is inexpensive, and electric wiring need not be long, because there are naturally nearby places for connection in any industrial plant. As a result, the unit heater may be placed anywhere at all where heat is desired, without regard to questions of steam circulation, cost of piping, insulation, traps, etc. With gas unit heaters, there need be no boiler, no stack, no accessories such as coal storage space, ash cans, coal handling equipment, no attendance is required, no regulation of water line, no maintenance in boilers, and then best of all, better than 90% of the heat is usefully recovered in the unvented type of unit heaters, and better than 80% for the vented types.

In a general article of this character, it is not possible to go into the details of the comparative first cost of any given installation, because each situation would naturally be different, but it does not take much imagination to picture the reduction in first cost when using gas unit heaters compared to the standard radiation steam boiler, piping, and all the accessories are thrown in.

The high efficiency of the unit heater is continuous *regardless of load* for the self-evident reason that all of the heat liberated on burning the gas is directly available in the room. The only losses which exist are the flue losses, which amount to about 17% for the vented heater, and the loss due to uncondensed water vapor in the case of the unvented heater. There is a difference of opinion on the latter point, however, because in many cases where condensation on and frosting of roof monitors or skylights is not serious, some of the water vapor is condensed and a portion of the latent heat recovered. In any event, the minute that the desired temperature is reached, and the controls shut off the unit heater, there is no loss, because there is no fuel being burned, and there is so little heat stored in the unit heater itself that there is no off period loss.

Gas unit heaters are available in a number of different styles and types. One of the first to appear on the market consisted of a forced air gas burner located underneath a bank of 80 chromium plated tubes. An electric motor operated the unit heater fan and extracted better than 80% of the heat of the gas burned from the tubular heating surface. When the fan was operating, the hand could be placed on the tubes in the upper section of the heater. Fig. 1 shows a typical industrial installation of unit heaters.

The second type of unit heater is generally similar in construction but has provision for the use of a multi-blade fan in place of the propeller type of fan, so that it can be used for duct distribution against positive resistance.

In addition to these types, there is a radical departure in a new unit heater which involves the use of revolving radiation in place of stationary radiation. This consists of a hollow-blade propeller fan so designed that the gas is burned inside of the hub of the fan wheel, and is discharged through the hollow blades into a shroud surrounding the wheel, and thus discharged into the vent. The big advantage of this type of unit heater is the possibility that it can be operated in any position, horizontal, vertical, discharging air up or down, and oscillating in its motion.

The output and air capacity of gas unit heaters are given in Table 1.

Another type of factory heating with gas which is relatively new is by the use of gas-fired air heaters with suitable duct connections. Such units can be set anywhere in any available space, operating without attention and under thermostatic control. They do not need a separate boiler room, and can be put wherever convenient. Very often some of the air may be usefully employed for drying rooms, and in this way process heating air and also building heating air are secured. This type of heater may also be placed up in

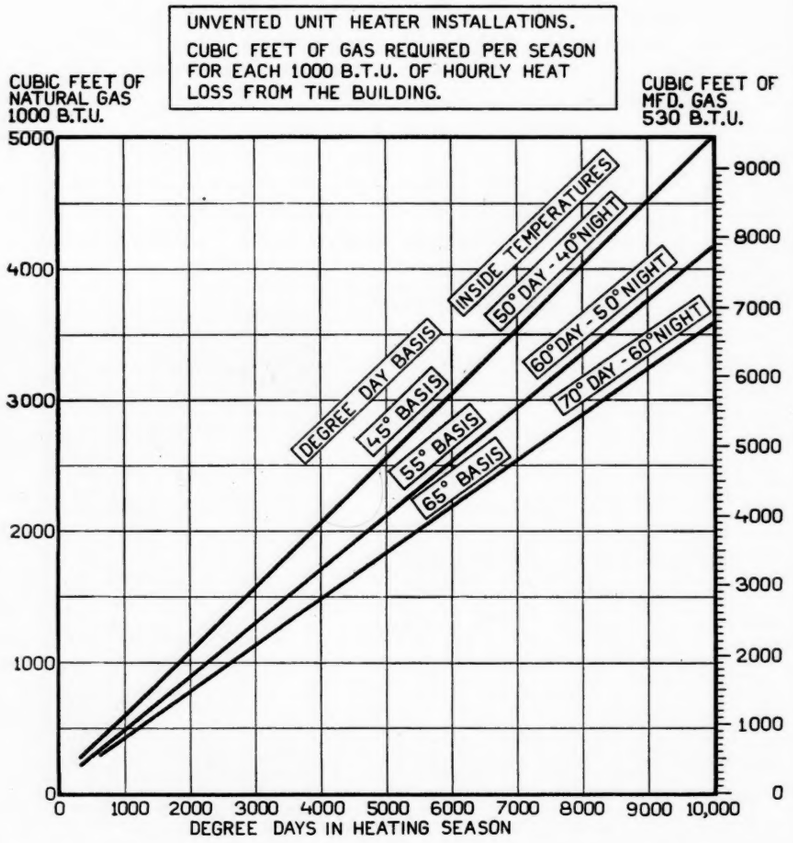


Fig. 3. Chart for Estimating Gas Consumption of Unvented Unit Heaters in Industrial Buildings

the air on an elevated platform, and the space below used for storage, driving machinery, or other industrial equipment.

A typical installation of this type of unit is shown in Fig. 2. This is an enclosed air heater for natural gas, used for a combination of building heating and drying. Since the drying air is vented into the room, all of the heat in the gas burned is ultimately available for building heating. It is difficult to give unit figures for this particular installation, because some of the heat was supplied by a large tunnel kiln with quite varying output. The general data for this building are as follows: 300 ft. x 280 ft. x 24 ft. high; modern type construction, having steel framing, brick walls, 60% glass surface, and built-up roof. Executive offices in outside bay on first floor occupied a space of 120 ft. x 20 ft. Heating requirements include building heating to 70° against an outside temperature of 0°, and to furnish large amounts of drying air at 160°.

There are five of these units in this plant supplementing the heat derived from the tunnel kiln. Waste heat from the kiln is collected by means of a piping system, drawing it to a mixing chamber where additional air brings the temperature to the desired level. A fan draws the air, distributing it through ducts to the various parts of the building for heating and drying. Connected into this supply system are the five gas-fired heaters, so designed that when the kiln is not operating, the gas heaters make up the heat requirements. Under full load conditions, about 45% of the air is required for drying and 55% for heating. Consequently, in the summer time a by-pass stack can be used to discharge a portion of the heated air directly out of doors.

It will be of interest to note the records of a number of different gas installations of the various types which have been mentioned.

Fig. 3 shows an installation of five boilers handling approximately 28,000 sq. ft. of direct cast iron radiation in a hospital at Great Falls, Montana. The advantages of gas for large building heating could hardly be better shown than in this installation, where so large a quantity of radiation is handled noiselessly and without attendance in a compact boiler room. It is not possible in the short space of an article to do justice to the many interesting features of such an installation.

Since the interest of many readers of this article will center in the possibility of using gas in existing coal boilers, Fig. 6 is worth a moment's consideration. This shows the conversion of an 80 hp. triple pass boiler, fired with natural gas.

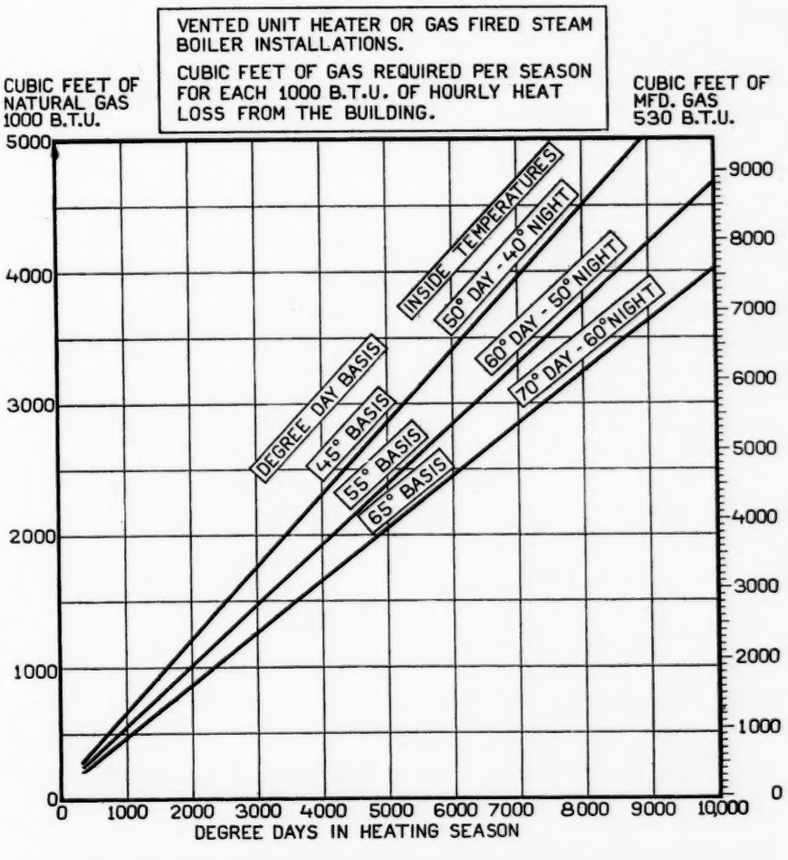


Fig. 4. Chart for Estimating Gas Consumption of Vented Unit Heaters or Steam Boilers in Industrial Buildings

Methods of Estimating Gas Required for Factory Heating

If this article has aroused the interest of any reader in the subject of gas for industrial building heating, it will certainly have raised the question: How much gas is going to be required?

This is not an easy thing to answer, because there are more variables in industrial heating than in domestic heating which tend to upset the best of calculation. This has already been suggested in the several plants where process work contributed a large share of the heat. Fortunately, in the cases in question the amount of heat contributed by the process was well known, and could readily be allowed for in making heating estimates.

However, a method for making a heating estimate has been developed and is quite useful. Having made the estimate, the contribution of heat from process sources can readily be detected, and then the amount of fuel used for gas building heating properly estimated.

Table 2 repeats some of the degree day data recently given in full in this magazine for industrial heating. This is degree day data for some leading natural gas towns based on a 45° and a 55° datum. This material is very useful where gas is the fuel.

Building Heat Loss

For industrial heating installations the heat loss is frequently figured on other temperature bases than 70° and 0°. For the purpose of illus-

TABLE 1—OUTPUT OF GAS UNIT HEATERS

Make and Model	B.T.U. Input per Hour	B.T.U. Output per Hour	Equivalent Sq. Ft. of Radiation		Cu. Ft. per Minute Heated Air	Temp. Rise of the Air	Type of Fan	H.P. of Fan
			Vented	Unvented				
Buffalo Forge Co.	150,000	120,000	500	563	2,300	48°	3 blade	——
Columbus Heating & Ventilating Co.								
Columbus No. 150	180,000	150,000	625	675	2,400	57°	4 blade propeller	1/3
							multiblade	1/2
Columbus M 2000	240,960	200,000	833	937	4,000	46°	multiblade	3/4
Columbus M 3000	361,445	300,000	1,250	1,351	5,500	50°	multiblade	1
Columbus M 4000	481,930	400,000	1,666	1,810	7,500	49°	multiblade	1 1/2
Columbus P 2240	240,960	200,000	833	937	3,000	61°	propeller	1/3
Columbus P 3300	361,445	300,000	1,250	1,351	4,500	61°	propeller	1/2
Columbus P 4360	481,930	400,000	1,666	1,810	6,000	61°	propeller	3/4
General Gas Light Co.								
Humphrey 100	100,000	83,000	346	375	1,900	40°	4 blade 1 1/8" P.	1/6
					1,780	43°	6 blade 1 1/2" P.	
					1,400	47°	6 blade 2 1/2" P.	
Humphrey 200	200,000	166,000	692	750	2,600	50°	6 blade	1/4
Texo Heater & Mfg. Co.								
Sterling 4	125,000	100,000	417	470				1/12
Sterling 5	156,000	125,000	520	585				1/6
Sterling 6	230,000	184,000	757	862				1/6
Sterling 7	335,000	268,000	1,120	1,250				1/4
Sterling 8	417,500	344,000	1,430	1,570				1/3
Sterling 10	536,000	428,000	1,780	2,000				1/3
Sterling 12	670,000	535,000	2,230	2,500				1/2

tration in this article, it is assumed that buildings are to be heated to 50°, 60° or 70°. The standard methods may be taken to arrive at the hourly heat loss of the building. The only difference in the calculation is to multiply the various coefficients by the corresponding temperature rise desired. This can be done even when different portions of a building are to be heated to different temperatures. Where this is the case, the internal heat interchange must also be calculated; that is to say, suppose a main portion of the floor is to be heated to 50°, while some small section used for office space, is to be heated to 70°. The heat loss for the 70° portion would be calculated in the usual way, but the wall dividing the 70° from the 50° portion would have a temperature differential of 20° to be used in determining the heat loss.

Data given in Table 3 are to be used in the method outlined in this section of the article to determine the annual fuel consumption. The details of this will be explained a little later. In the case of residence heating, a relationship was discovered showing that when the outside twenty-four hour average temperature fell below 65°, the usual household turned on its gas heating system. That is to say, approximately a 5° differential between the twenty-four hour outside temperature and the desired indoor temperature occurred before heating units were placed in operation. The similar relationship for industrial building heating has not yet been ascertained. Therefore, in the absence of definite information, the same differential will be assumed, although it is quite possible that this will have to be changed when more information is available. For this reason, the degree day table on a 45° and 55° basis corresponds to industrial building heating requirements of 50° and 60° indoor temperatures respectively.

TABLE 2—INDUSTRIAL DEGREE DAYS IN VARIOUS CITIES SUPPLIED WITH NATURAL GAS

City	Degree Days 45° Basis	55° Basis
Cincinnati, Ohio.....	1376	3003
Cleveland, Ohio.....	1525	3795
Denver, Colo.	1548	3440
Kansas City, Mo.....	1463	2980
Memphis, Tenn.	....	1284
Oklahoma City, Okla....	600	1835
Parkersburg, W. Va.....	1147	2784
Pittsburgh, Pa.	1377	3028
Rapid City, S. D.....	2590	4628
Salt Lake City, Utah....	1475	3202

Gas Requirements

Table 3 shows the B.t.u. required per degree day for each 1000 B.t.u. heat loss per hr. from the building. The table is worked out for various combinations of temperature inside

TABLE 3—B.T.U. REQUIRED PER DEGREE DAY FOR EACH 1,000 B.T.U. OF HOURLY HEAT LOSS* FROM INDUSTRIAL BUILDINGS†

Daytime Inside Temperature	Minimum Outside Temperature	Time in Hours	Degree Day Datum	Efficiency			
				75%	80%	85%	90%
70	0	24	65	480	450	424	400
60	0	24	55	568	532	501	473
50	0	24	45	694	651	612	578
70	0	16	65	457	429	403	381
60		8					
70	0	10	65	440	412	388	366
60		14					
60	0	10	55	509	477	450	424
50		14					
50	0	10	45	607	569	506	456
40		14					

*Heat loss figured to maximum inside temperature corresponding to desired estimate.
†Sunday and holiday temperatures assumed the same as the night temperature.

and outside maintained for varying periods of time. In the case where different temperatures are maintained day and night, allowance has been made in the figures for the fact that Sunday and holiday temperatures will probably be the same as the night time temperatures. If the proposed temperature conditions are different from the tabular values, it is quite easy to make the corresponding percentage correction. These figures are given for efficiencies from 75% to 100%, so that for any given situation a choice of the data is necessary. These figures are used as follows:

First find out how many B.t.u. are lost per hour from the building under the desired conditions. Then multiply this by the number of degree days (on the proper basis to correspond to the desired building temperatures), and again by the constant selected from the table and divide this product by the B.t.u. per cubic foot of the local gas. The result will be the estimated consumption in cubic feet for the season.

This is a relatively simple method, but it is necessary to select the correct efficiency, and also to be careful in dealing with problems where different portions of the building are to be kept at different temperatures. The recommendation would be as follows:

A figure of 80% efficiency is a safe one to use for estimates with steam boiler plants or vented unit heaters. For unvented unit heaters, the figure of 90% is the proper one to use. For converted installations, a 75% figure will be reasonably safe.

In the case where the temperature has to be different in different parts of the building, the estimate should be made for each portion as if it were a separate heating plant.

Where the number of degree days is small, the efficiency will drop off in the case of steam boilers, because of the relatively long "off periods." Although it is difficult to state just where the line is to be drawn, it is probable that for territories between 1000 and 3000 degree days on a 70° basis, or up to 2000 degree days on a 60° basis, will run efficiencies as much as 10% lower than the values given. On the other hand, most of these southern localities do not calculate with 0° as the minimum outside temperature.

Condensation from Unvented Unit Heaters

This problem is not very serious, as has been mentioned before, because the ventilation in most industrial buildings is rather high. There is some possibility, though, of causing frosting, especially on the roof. To overcome this, it has been suggested that a suitable elbow on top of the unit heater flue connection could deflect the flue gases in such a way that they will be caught by the air blast through the heater. This would mix them with the heated air and dilute them, at the same time usefully employing the heat which they contain. Since they would not collect directly under the roof, the chance for condensation trouble is pretty limited. There is no danger of raising the humidity of the room air above 40% to 50% relative humidity, because the natural ventilation will keep the relative humidity below this amount. In the case of a piece of equipment of this kind, it will be necessary to design it so that it would not produce an undue pull on the gas flames.

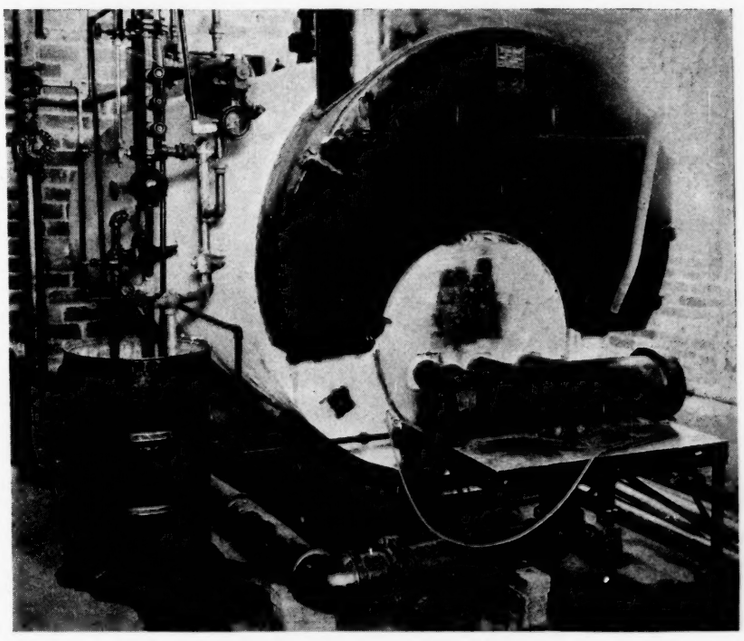


Fig. 6. View of 80 Hp. Gas-Fired Boiler Showing Burners, Manifold and Mercoid Switch for Controlling Water Level

Charts for Quick Estimation

The two charts are for the purpose of short-cutting the steps which have been outlined in the method for estimating gas consumption. One chart is for use with vented unit heaters or gas-fired steam boiler installations, and the other is for unvented unit heater installations.

The charts read directly in cubic feet of natural gas per season in the left hand scale, and in cubic feet of manufactured gas per season in the right hand scale.

It is only necessary to extend a line from the proper number of degree days to the curve which represents the operating conditions of the plant, and then the cubic feet of gas required per season for each 1000 B.t.u. of hourly heat loss from the building can be read.

Suppose, for example, that it were desired to check the industrial plant estimate worked out with a different method in the 1930 report of the American Gas Association House Heating Committee. The report indicates that a given building had 715,000 B.t.u. loss per hr. when the inside temperature was to be maintained at 60°. Sundays and holidays and nights (14 hours out of each day) a temperature of 45° was to be maintained, and there were 4122 degree days on the 55° basis.

Using the steam boiler chart, we find that exactly 2000 cu. ft. of

natural gas are required per season for each 1000 B.t.u. of hourly heat loss. Therefore, the building heat loss for the season is 2000 x 715, or 1,430,000 cu. ft. Since the temperature was to be 45° at night instead of 50° as indicated on the chart, this corresponds to about 14% decrease. This would bring the annual consumption to 1,230,000 cu. ft., which checks the estimate of 1,235,000 by the other method.

Conclusions

Summarizing the picture of gas for industrial building heating, the following general conclusions are found:

First, the gas-fired unit heater offers exceptional advantages for lower first cost installations and for bringing the cost of gas to figures not very different from the cost of competitive fuels. Moreover, the general practice of gas companies is to service and maintain such equipment.

Second, where rates are attractive, standard forms of radiation connected to gas boilers are growing in popularity. Here too the gas company undertakes the problem of service, so that the plant owner has an entirely automatic heating equipment, free service, and no smoke, ashes or dirt to contend with.

Oil

by **CLIFTON L. BUTLER**

IT is generally conceded that fuel oil is an ideal fuel and that it has many practical advantages such as:

(a) High combustion efficiency can be readily attained.

(b) Maintenance expenses of the furnace and boiler are low.

(c) Ready control over the operation of the boilers is possible due to the ease with which fires can be started, regulated and stopped. This is particularly important where there is a varying load on the boilers.

(d) Since by its nature oil can be burned by means of automatic devices, but little labor is commonly required in the boiler room.

(e) There are no ashes, dirt and dust, and smoke can be practically eliminated.

(f) Storage space is small, and tanks can be placed under ground using otherwise valueless space. The

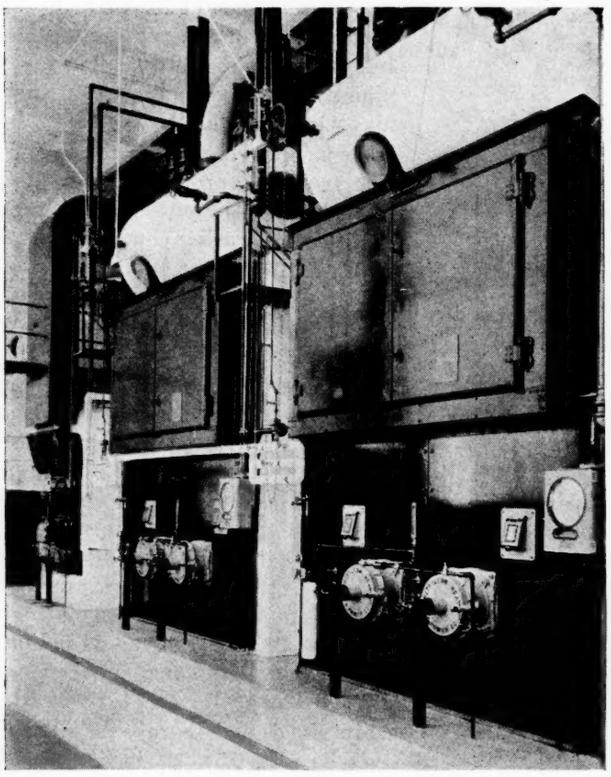


Fig. 1. Installation of Oil Burning Equipment in Large Printing and Engraving Plant

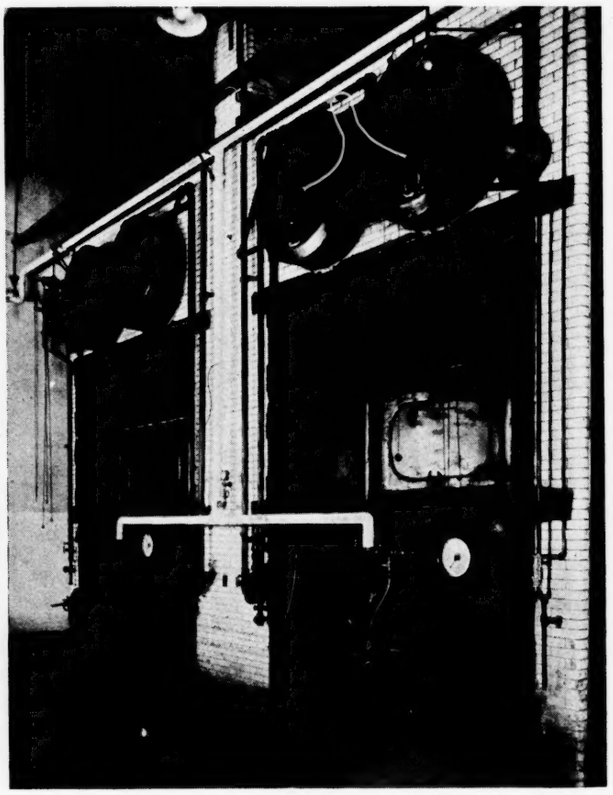


Fig. 2. Typical Oil Burner Installation in Candy Factory

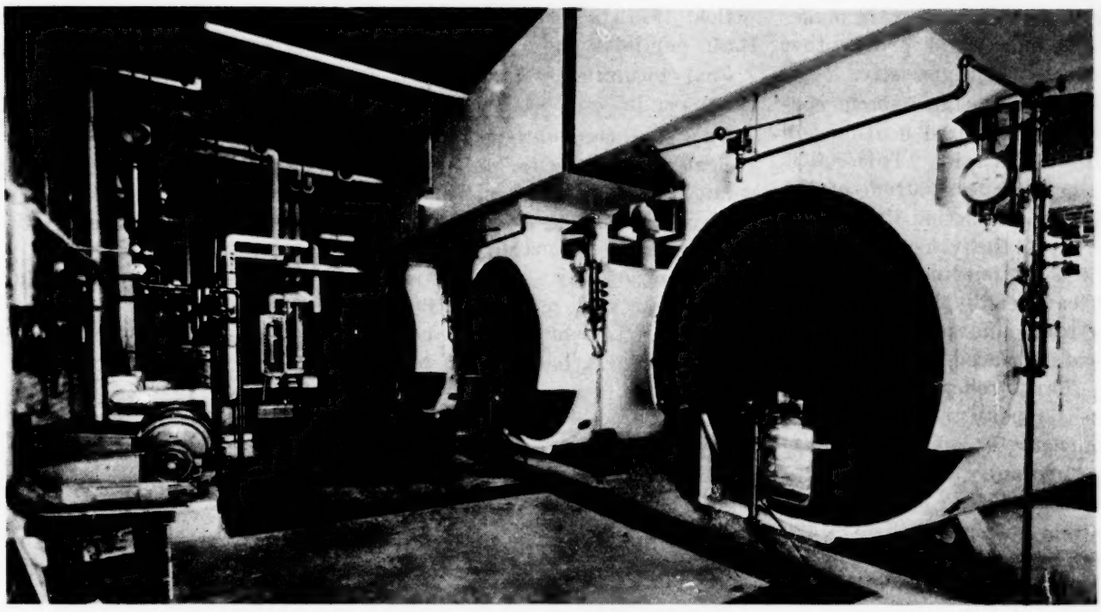


Fig. 3. Oil Burner Installation in Plant of Biscuit Company. Two Burners Use No. 5 Oil, the Third, No. 3 Oil

fuel does not deteriorate in storage.

Much has been written regarding the supply of oil and the possibility of the exhaustion of the supply, but when consideration is given to the fact that the oil producing and proved area in the United States totals over 3,000,000 acres and that there are in the United States over a billion acres of land of geological formation favorable to the presence of oil and that within this area new fields will undoubtedly be found; further, that in the background of this large potential liquid supply is the promising development of extraction from oil shale, the supply of which is almost unlimited, and the development of coal and lignite distillation processes which will produce large quantities of oils suitable for fuel, the question of supply assumes rather small proportions. In addition to the above sources of oil supply in the United States it must be remembered that Russia, Mexico, Canada, Venezuela, Columbia and other foreign countries also have large producing oil fields.

As it comes from the earth crude oil is, non-technically speaking, a mixture or compound of many valuable and useful oils, each of which has an important commercial use. Crude oil is separated into these several useful oils among which are gasoline, kerosene, gas, oil, etc., by distilling and refining processes and the fuel oil used for heating purposes may be called a reduced crude oil or residuum and is the product, generally speaking, which remains after the lighter oils have been removed from the crude by distillation.

Over a year ago a joint conference of representative refiners, distributors and consumers of fuel oil, manufacturers of oil burners, and general interests, adopted a commercial standard for domestic and industrial fuel oils. The industry has since accepted and approved for promulgation by the Department of Commerce the specifications as shown below:

COMMERCIAL STANDARD DESIGNATION		
Specification Number		Name
1	—	Light domestic fuel oil
2	—	Medium domestic fuel oil
3	—	Heavy domestic fuel oil
4	—	Light Industrial fuel oil
5	—	Medium Industrial fuel oil
6	—	Heavy Industrial fuel oil

Due to the fact that the gravity of fuel oil did not provide definite classification, the above specifications were prepared and each specification definitely fixes the characteristics of the several grades of fuel oil. Generally speaking, however, the oils covered by specification Nos. 1, 2 and 3 are used in the domestic full-automatic type of oil burners used in house-heating, while the oils covered by specification Nos. 4, 5 and 6 are used in the industrial type of oil burners, usually installed in commercial or industrial buildings, hospitals, power plants, etc.

Oils covered by specification Nos. 1 to 4 inclusive, do not require preheating equipment. Installations where the use of specification No. 5 oil is contemplated should include preheating equipment for use under certain conditions and preheating equipment should be provided on all installations where the use of specification No. 6 oil is contemplated. Oil burning systems installed in industrial buildings, particularly the larger ones, usually burn the heavier grades of fuel oil covered by specification Nos. 5 and 6.

OLD DESIGNATION	
Approximate Gravity Range	Name
40–36° Be.	Distillate
36–32° Be.	Gas Oil
32–28° Be.	Light fuel oil
28–24° Be.	Medium fuel oil
24–18° Be.	Heavy fuel oil
18–12° Be.	Very Heavy fuel oil

The necessity for using preheating equipment is determined by the viscosity rather than the gravity of the fuel oil, viscosity being a term applied to the internal friction or resistance to flow offered by the oil. The time required for a definite amount of oil to flow through an orifice of standard size is a relative measure of the oil's viscosity. If it takes a long time the number representing the seconds is large and the oil is said to have a high viscosity whereas should the oil be very fluid the time required is less and consequently the viscosity is said to be

low. Raising the temperature makes viscous oils more fluid or in other words reduces their viscosity.

A typical preheating system consists of a suitably sized heating coil in the oil storage tank. This coil is usually placed at the bottom of the tank near the oil suction line and is used to reduce the viscosity of the oil, near the suction line, so that the oil pump can readily handle the oil from the tank, and pump it to the oil preheater placed near the oil burners. This preheater raises the oil to the temperature required by the oil burners for efficient atomizing and burning. Naturally there are variations of this arrangement.

Preheating systems utilize either steam or water for heat depending on local requirements and conditions at each individual installation.

Oil is sold by volume, and often included in the oil specifications is the minimum heat value of the oil, usually reported as B.t.u. per pound. Generally, the lighter the gravity of the oil, the higher the heat value of the oil per pound. This fact has led some people to believe that it is more economical to purchase lighter oils in preference to the heavier fuel oils but they have lost sight of the fact that as the heat value per pound increases, with the higher gravity, the number of pounds per gallon decreases so that the actual heat units in the oil per gallon, which is the unit on which the price is based, are less in the lighter gravity oils than in the heavier fuel oil.

To illustrate: No. 6, heavy fuel oil, has approximately 18300 B.t.u. per lb. but weighs at least 8 lb. per gal. which means that a gallon of this oil contains about 146,400 B.t.u. per gal. whereas a gallon of No. 4, light fuel oil, for instance, will contain only 142,500 B.t.u. per gal., regardless of the fact that analysis may show about 19,000 B.t.u. per lb., because of the fact that this oil weighs only about 7½ lb. per gal.

Now let us consider the relative heating values of the fuels more commonly used for heating in industrial buildings.

Fuel oil 136,000 to 146,500 B.t.u. per gal.

Natural gas 850 to 1,000 B.t.u. per cu. ft.

Manufactured gas 300 to 600 B.t.u. per cu. ft.

Coal (anthracite) 11,400 to 12,800 B.t.u. per lb.

Coal (bituminous) 11,500 to 13,500 B.t.u. per lb.

Fuels are frequently compared on a heat content basis; for example, it might be said that a gallon of fuel oil is equivalent to so many pounds of coal or to a certain number of cubic feet of gas. The figure obtained from such a computation is a true comparison of the heat content of the two fuels, but is not a reliable index to the comparative cost as it does not take into consideration the efficiency with which the fuel is consumed. The efficiency is the measure of the amount of heat that is taken from the fuel for useful work as compared to the total heat content of the fuel.

The following general formula gives the factors required in making a comparison between fuel oil and coal.

Let X = Number of gallons of oil required per year.
C = Number of tons of coal used per year.
HC = B.t.u. per pound of coal.
HO = B.t.u. per gallon of oil.
EC = Efficiency of coal burning plant.
EO = Efficiency of oil burning plant.

$$X = \frac{2000 \times C \times HC \times EC}{HO \times EO}$$

A similar general formula gives the factors required in making a comparison between fuel oil and gas.

Let X = Number of gallons of oil required per year.
G = Number of cubic feet of gas used per year.
HG = Heat content of gas per cubic foot.
HO = Heat content of oil per gallon.
EG = Efficiency at which gas is utilized.
EO = Efficiency at which oil is utilized.

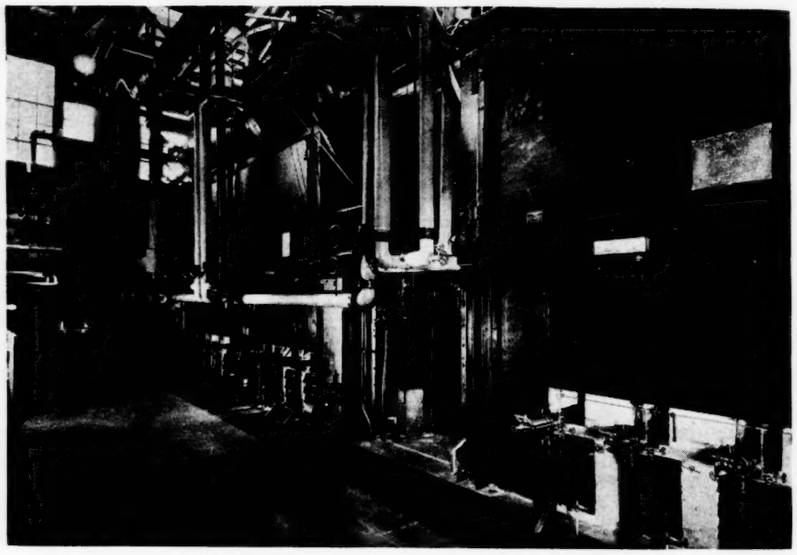


Fig. 4. Typical Fuel Oil Burning Installation in Water Tube High Pressure Boilers Using Preheated No. 6 Fuel Oil

$$X = \frac{G \times HG \times EG}{HO \times EO}$$

Substitution in this formula gives a comparative fuel cost between gas and oil as obtained between coal and oil above.

Cost comparisons must be accompanied by complete information as to the known factors such as the cost per unit which may be pounds, cubic feet, gallons, etc., heat content per unit; initial installation cost, etc., and the assumed or estimated factors such as the efficiency with which the heat content of the fuel can be utilized; fuel handling costs, etc.

The question of comparative fuel cost is an interesting one but is also one which must be handled with discretion especially by enthusiastic salesmen who are inclined occasionally to exaggerate statements regarding fuels handled by their respective equipments with rather unsatisfactory results from ultimate prospects.

Some of the results of a typical

test run on a 175 hp. 78 in. x 18 ft. long H.R.T. boiler which was converted from coal firing to oil firing are given below. This operating test was run by a prominent firm of testing and consulting fuel engineers and in accordance with A.S.M.E. boiler test code.

Test No.	Boiler Rating Developed, %	Equivalent Evaporation per Lb. of Oil	Developed Efficiency, %
1	25	12.66	65.3
2	45	13.26	68.4
3	97	14.32	73.9
4	166	15.29	78.9

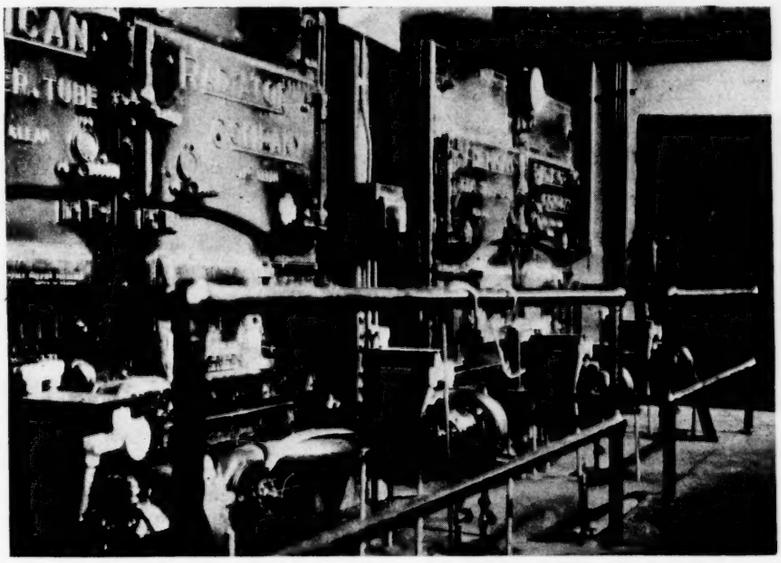


Fig. 5. Industrial Heating Plant Oil Burners Installed in Cast Iron Boilers in Paper Plant in Maine

Each of the above tests consisted of a three hour run at each boiler rating. Steam pressure carried on the boiler throughout the duration of the test was approximately 75 lb. and the temperature of the boiler feed water averaged 190° F. Draft in the furnace was approximately 0.10 in. of water. The average CO_2 content of the flue gas during two higher rating tests was 13.4% with the temperature of stack gases ranging from 344° F. at 25% rating to 537° F. at 166% rating.

No. 6 fuel oil containing 18,794 B.t.u. per pound (dry) was used throughout the test period and the temperature of the oil as fed to the burners was approximately 200° F.

Oil burners were of the pneumatic turbine driven mechanical type and the boiler was equipped with two burners. Eight boilers of similar type and size comprise the plant which is completely equipped with oil burners.

There are two general methods of burning oil in a boiler furnace. One method is to atomize the oil by means of steam or compressed air, the other method is mechanical atomization. Naturally there are many subdivisions of burners under each of the two above general headings. With properly designed furnaces and combustion chambers oil burners will efficiently fire the many types of heaters whether steam, hot water or warm air.

The illustrations, Figures 1 to 5, show typical installations of oil burning equipment adapted to various types of boilers commonly used in heating plants of industrial buildings. The illustrations show the cleanliness and compactness which can be obtained with oil burning equipment.

The boiler room, Fig. 3, contains three Scotch marine type boilers each rated at 200 hp. and operating at a maximum steam pressure of 15 lb. per sq. in. The oil burners are of the mechanical atomizing type, pneumatic turbine-driven and of sufficient capacity to operate the boilers at 150% rating. Oil used as fuel is No. 5 and is burned without preheating. Burners are operated through high-low oil flame and are controlled from a diaphragm regulator actuated through steam pressure on each boiler. This control not only varies the amount of oil being fed by the pump to the burners but also varies the primary and secondary air supply to each individual burner through the movement of one valve arm at each burner. The secondary air supply into each boiler is induced by the natural draft chimney serving the entire plant.

Oil pumps and fans for oil and primary air supply to the burners are in duplicate, each unit being of sufficient size to furnish maximum oil and primary air requirements, thus affording a complete duplicate unit for alternate or emergency service. Each unit is driven by a direct-connected motor.

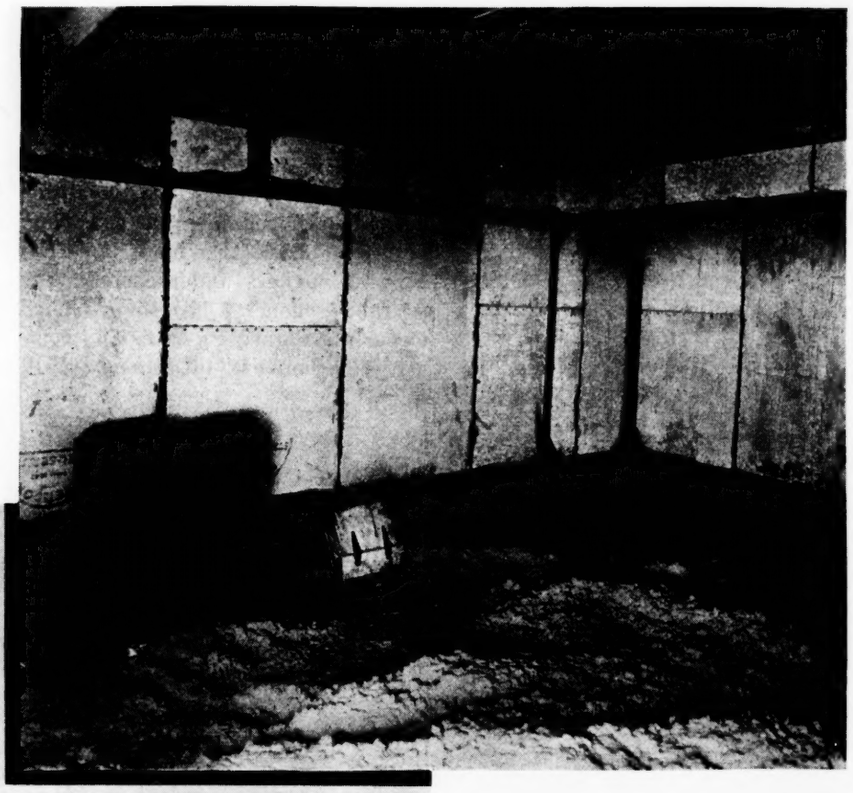
Oil deliveries are made to the oil storage tanks from tank cars and the oil pumps take suction direct from the tanks. Tanks are located inside the building in a room adjacent to the boiler room.

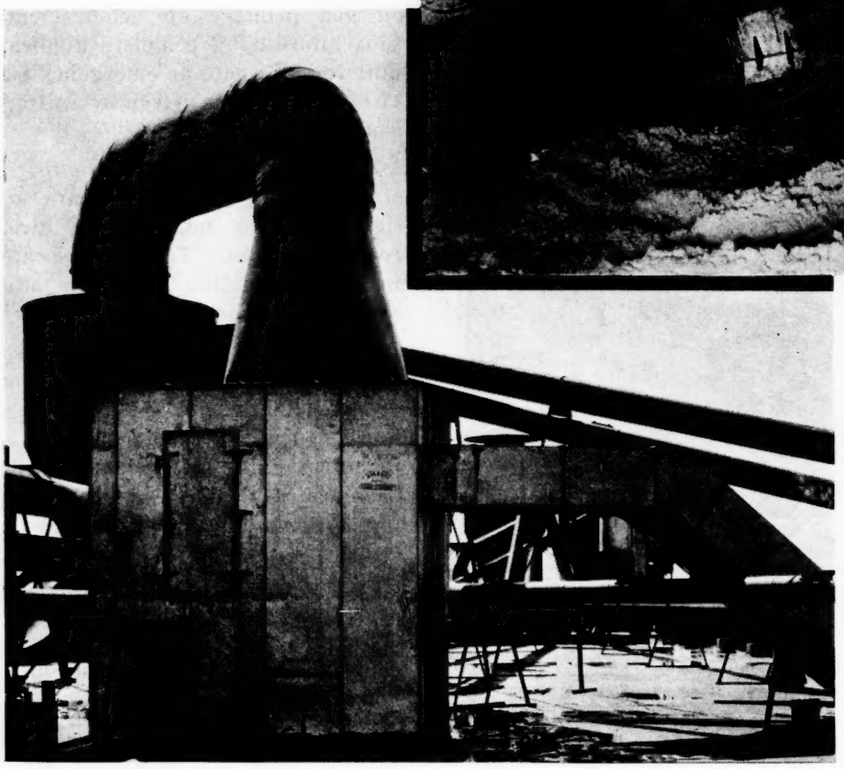
The heating system is the typical two pipe vacuum system with condensate pumps capable of maintaining a 10 in. vacuum and also of pumping against the maximum boiler pressure of 15 lb. Cast iron radiators are located on the walls and in the monitors of the buildings. Unit heaters complete with ducts, enclosures, fans and heating coils located throughout the buildings are arranged for future installation of humidifying units.

This installation has proved satisfactory from an operating standpoint, is efficient and flexible and capable of maintaining a uniform steam pressure on the boilers.

Those contemplating the building of new plants or the changing of their present heating plants should feel free to call on any of the several manufacturers or distributors of industrial fuel oil burning equipment for complete unbiased information and data regarding the advantages, cost, etc., of the use of oil as fuel. The American Oil Burner Association also maintains a staff of technical experts who are glad to give those interested the benefit of their knowledge which has been compiled from actual tests and experience from the past several years.

Selection of Air Filters





by **HOWARD C. MURPHY**

Above—Dust Chamber of Filter House. Accumulation of Linty Dust Collected in Two Days Operation.

Left — Air Filter Dust Arrester Installed on Factory Roof, Handling Wool and Cotton Lint. Clean Air from Filters Returned to Workrooms.

IN considering the use of air filters for industrial applications, it is usually possible by a careful analysis of the conditions to decide whether the installation would be justified or not.

Due to recent advances in our knowledge of this art, substantial savings are sometimes possible in unlooked for places. One of the leading manufacturers of gold spectacle frames—a firm internationally known for their outstanding product and engineering ability — formerly discharged the air from its workshop out of doors. By installing air filters the air was recirculated, saving fuel and recovering appreciable quantities of gold from the air. In fact, the air filter sheets, costing approximately five cents when new, were worth ten dollars each in readily recoverable gold after one month's operation. The installation showed an annual saving, according to a careful check and industrial survey, of $1436.35, a return of 375% on the filter investment.

A large manufacturer of wool and cotton lint for automobile seat pads was faced with considerable difficulty in heating his workrooms in cold weather. Moreover, the cyclone dust arresters were unable to trap the very fine cotton lint which covered the neighborhood, and health authorities threatened to shut the plant down. Air filters, utilizing sheets of cellulose tissue, were installed on the roof and connected to the exhaust of the cyclone.

Filtered air was returned to the workshop with material savings in fuel costs. The owner reports that heating costs during the winter 1929-30, which was an exceptionally cold one, were $2,128.49 less than during the previous winter. At the same time the temperatures in the workrooms did not fall below 60° to 65° instead of 30° as formerly. Drafts have been completely eliminated. The recovered material, which consists of fine cotton fibres, has been found to be valuable and is sold at a good price. The load on the exhaust fans has been reduced in spite of the addition of the air

filter, as the air is now recirculated.

A prominent meat packing firm had continued complaints of mould in its package bacon. Every precaution to insure immaculate cleanliness in their bacon slicing departments was observed, the operators were dressed in white uniforms and the establishment fairly shone with cleanliness. Despite this, however, customers continued to complain of mouldy bacon. Air filters were installed in their ventilating system to remove the mould spores from the air and mouldy bacon was eliminated.

A tomato packer in Detroit, who ripens his product by forced ventilation, found a considerable percentage spoiled by air borne mould spores. The installation of air filters eliminated this source of lost profit.

When industrial dust conditions are severe, the economic need of air filters is usually apparent. In industrial plants such as steel mills, paper mills, plants with explosive dust, valuable dust, poisonous dust, etc., there are frequently possible direct and very evident profits in the application of suitable air cleaning devices.

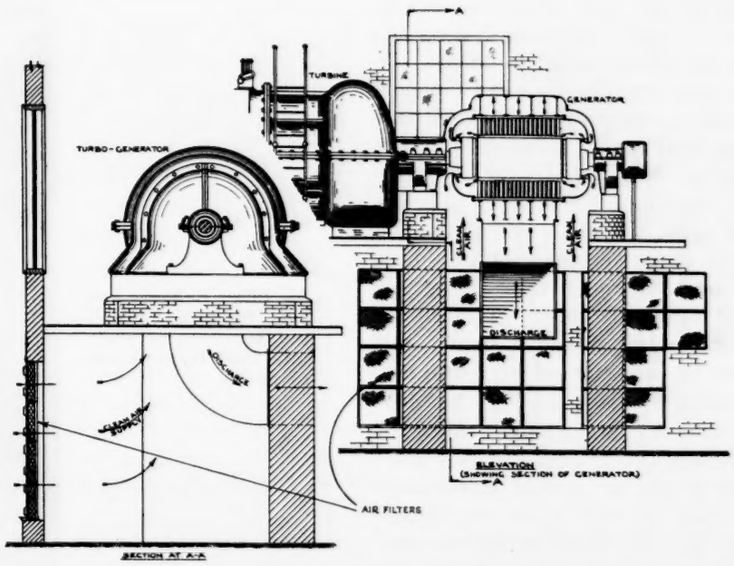
In the ventilation of electrical machinery the use of uncleaned air allows deposits of soot, coal dust and carbon to collect on the windings and insulators. These being conductors of electricity may cause short circuits. At the same time even a thin coating of non-conductors will prevent the proper dispersion of heat and cause excessive operating temperatures.

Applied to compressors and internal combustion engines, air filters prevent unnecessary wear, eliminate frequent valve cleaning and reduce lubricating oil consumption by keeping dust and grit from entering the cylinders.

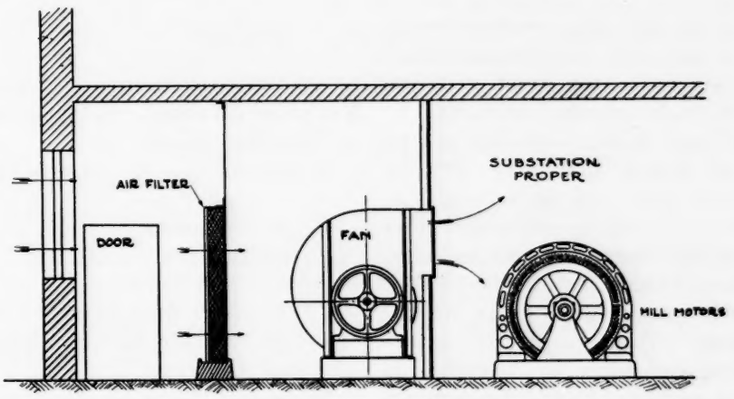
For drying material such as milk, gelatin, glue, butter, eggs, starch, laundry work, paper, wool, yarn, cotton, chemicals, paints and varnishes, air filters have many economic possibilities.

In the booths used for spray painting, air filters of a special type are a decided advantage, often allowing the recirculation of heated air and utilizing space that would otherwise be unsuitable for this work.

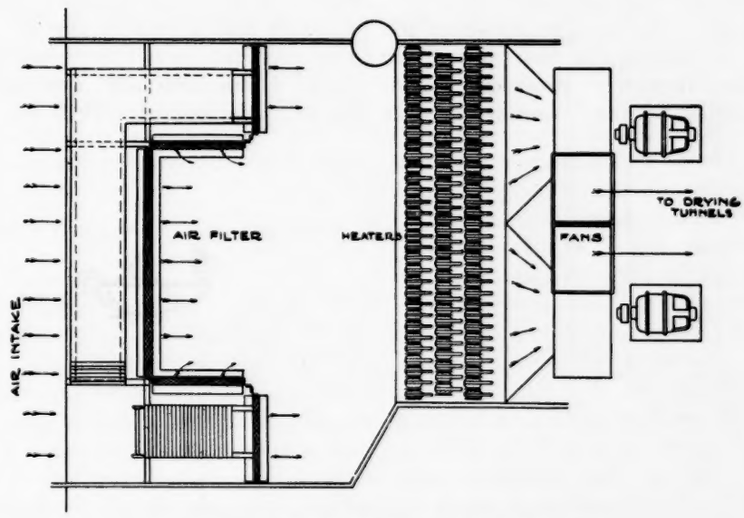
The influence of proper ventilation as a health protection for the workman is today properly receiving close



Application of Unit Filter (Viscous Type) in Ventilation of Turbo Generators



Arrangement of Unit Viscous Filters for Ventilating Mill Motors



Arrangement of Air Filters in Industrial Plant

attention not only from the standpoint of human relations but on the basis of direct losses in dollars and cents due to absentees and underefficient operatives. It goes without saying that many disease germs are airborne (dust borne), for the ordinary bacterium is relatively as heavy as an apple and would fall of its own weight if it were not caught on a dust particle and carried along for considerable distances. Science today traces the spread of many epidemics to this method of contagion.

Economic losses due to the common cold are staggering. Most of us average two or three colds a year, and it would be a bold statistician who would attempt to put into figures the productive losses of the country due to this item alone. Today we have learned to view with suspicion many of the early spring and fall colds, especially the cold which lingers. These are frequently a form of hay-fever, or pollenosis, caused by pollens and other protein impurities of the air which sometimes have been air borne for great distances due to their extreme lightness.

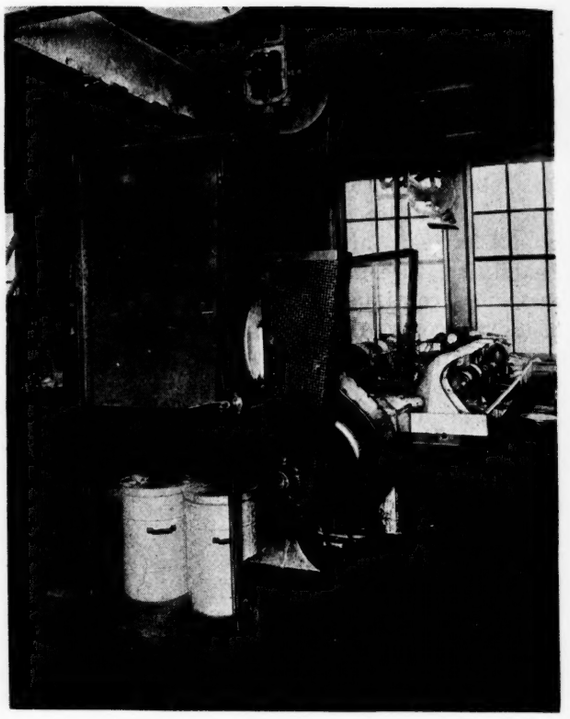
The best medical opinions are today in accord that over 95% of hay-fever and from 30% to 50% of asthma is caused by pollens and other protein air impurities which can be, and are, filtered out of the air by properly designed systems of air filtration. Diseases of this nature can unquestionably be controlled in a large number of cases by commercial air filtration. This is one of the newer conceptions of air conditioning but one which has gained rapid acceptance from the medical profession and engineers.

In order to intelligently select the type of equipment best suited for various industrial problems a consideration of the essential features of the different designs is desirable. The principal commercial types might be classified roughly as:

1. Viscous type for ventilation
   a. Unit
   b. Automatic
2. Dry type for ventilation
   a. Cloth units
   b. Wood fibre units
3. Dry type for dust separation and recovery

In general it can be said that the unit type viscous filters usually consist of a heavy metal frame arranged to carry an all-metal interchangeable filter unit. The construction of the unit and the filter media varies in different makes, but in general they give excellent service for ventilation work where ordinary atmospheric air is to be cleaned. They are not, however, suitable for heavy dust concentrations, air with considerable fibrous or linty contents, or for dust separation and recovery. The operation of cleaning and recharging these units is not a difficult one, but because of the very simplicity, they are sometimes neglected.

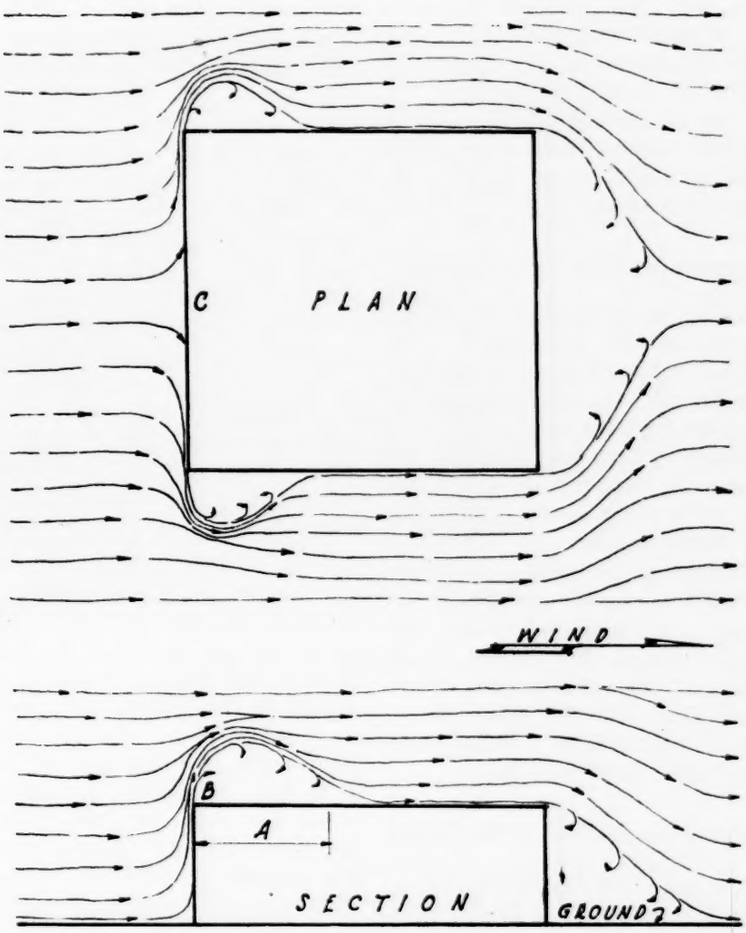
The usual automatic viscous air filter operates on the same general principle as the unit viscous type. It is, however, arranged so that the filter operates automatically, eliminating the need of attention and insuring continued uniform performance. It is especially desirable where continuous service is required. Automatic filters are made in a number of different designs suitable for almost all the usual conditions met with in industrial work.



Air Filter Exhaust System, Making Possible the Recovery of Valuable Dust from Workroom Air.

Industrial Airation

by **W. C. RANDALL**



The Jump of Wind from Windward Face of Building. (A—Length of Suction Area; B—Point of Maximum Intensity of Suction; C—Point of Maximum Pressure)

CORRECTNESS in the design of the fenestration, because of its permanence, for airation (natural ventilation) and daylighting is of more importance than in the design of mechanical equipment. It is evident that mechanical equipment often can be changed to produce better results at a reasonable cost, but once the building is built, airation and daylighting equipment, as represented chiefly by the window and building design, can be changed only at great expense and difficulty.

Airation, or flow of air, by natural means, through windows or other openings is caused by two agencies, wind and temperature difference. Wind is a reliable source of energy for the airation of buildings. A casual examination of Weather Bureau statistics indicates that the wind is much more reliable then is usually thought. Far from saying that airation is subject to the vagaries of the wind, it should be stated that wind is reasonably constant, not only as to direction, but velocity as well. Reports show that for each locality there is a prevailing wind, the direction of which holds constant for several months and for the same group of months year after year, and that the average velocity varies within comparatively small limits throughout the year. If there are heat producing processes within the building, we have another dependable agency—temperature difference.

Importance of Coordination in Design

In order to have efficient and effective airation, these two forces must be coordinated, not only to secure the most effective air flow, but also to avert such idiosyncrasies as are apt to occur when the flow due to the motive force of the wind is opposed by the flow induced by temperature difference. As a matter of fact, peculiar and unexpected things happen in mechanical ventilation and heating which frequently can be traced to the fact that the wind is assisting or opposing the action of the mechanical system.

For instance, the problem of heating rather than that of airation or ventilation is a principal reason for the acute condition that at times prevails in garages due to the presence of carbon monoxide. Objections to carbon monoxide gas were found to occur, with very few exceptions, during certain periods of the year. Practically no trouble was experienced since doors and windows were usually open. To a large extent, adequate air can be supplied to garages by natural means. As cold weather sets in, more and more of the ventilation openings are closed in order that comfortable temperatures can be maintained within the

buildings until, on extremely cold days, very few windows are open, with a result that the carbon monoxide concentration runs high. The closing of ventilation openings usually can be charged to either an insufficient heating installation or one operated much below capacity for economic reasons.

Important Factors in Design

Just as in mechanical ventilation, the methods for securing satisfactory natural ventilation, or airation, must be carefully studied, designed and built into the structure. It is necessary to take into consideration not only the fenestration or arrangement of window openings, but also such items as the size, shape and orientation of the building; size and proximity of nearby buildings; the occupancy or industry housed in the structure; and the direction and velocity of prevailing winds. When this is done and the windows are logically manipulated, satisfactory and effective airation follows.

Air Movement Due to the Wind

When the wind strikes a building, or other obstruction, it is forced to hop or jump over the top and around the sides. The surrounding air streams present a resistance to this deflection and, consequently, force the deflected currents back to a normal parallel flow again at some place farther downstream, as shown in Fig. 2. This action is similar to the flow of water around a boat or other object in a stream rather than the flow of water from a hose directed at an object, where the water merely splashes out practically parallel to the obstructing face.

Wind builds up a pressure against the obstructing face of a building and, therefore, will force air in at any openings located in this face. Within the region enclosed by the arcs of the air streams, which are deflected over and round the building, there exists a condition of partial vacuum which is strongest near the windward face, gradually diminishing to zero, or normal atmospheric pressure, somewhere near the reconvergence of the deflected air streams. This suction effect is illustrated when the driver of an automobile smokes with all the windows closed, except the one in the door at his left. The rush of air around the windshield creates a vacuum that pulls the smoke out of the open window.

The amount of the disturbance in the air streams depends, naturally, on the size of the building or obstruction. The size, therefore, determines the distance, and consequent area, over which the so-called suction zone extends. This area has been found to be a function of the square root of the area of the windward face and to be uninfluenced by the velocity of the wind. On the other hand, the intensity of the suction or vacuum, itself, is determined only by the speed of the wind, varying with the square of the velocity.

Wind, therefore, acts in two ways on windows or other openings in a building. At openings in the windward side, air is forced in, and at those located within the suction zone created by the deflected air streams, air is pulled out by that suction. If the window openings are so located as to take advantage of these two forces, any required quantity of air may be moved into, through and out of a building.

For industrial buildings, the usual fenestration calls for low sidewall windows for inflow, and roof openings (usually in a monitor) for outflow. If the side walls of a building are high and the monitor low, it is quite possible that the wind will jump clear over the monitor and thus put the entire monitor in a suction area. However, the monitor is usually high enough to extend up into the air streams above it, and air may be forced in if the windward side is open. This might not be objectionable in some buildings, but, by closing the windward side, the openings in the leeward side, due to the suction created, are forced to draw their supply of air from the lower portion of the building, thus creating a greater air movement in the working zone. While opening all windows will usually pass the greatest amount of air through the building, a good general rule to follow is to close upper windward openings.

When the wind is blowing diagonally against a building, as is quite frequently the case, the pressure exerted is considerably less than when the wind's direction is perpendicular to the wall. The suction on the lee side, however, is not decreased in the same proportion. When the wind is blowing at an angle of about 15° or 20° to one wall, the pressure at windward openings is practically zero. However, there still exists a suction on the lee side so that if the leeward monitor windows are opened, we can still secure an air flow through the building.

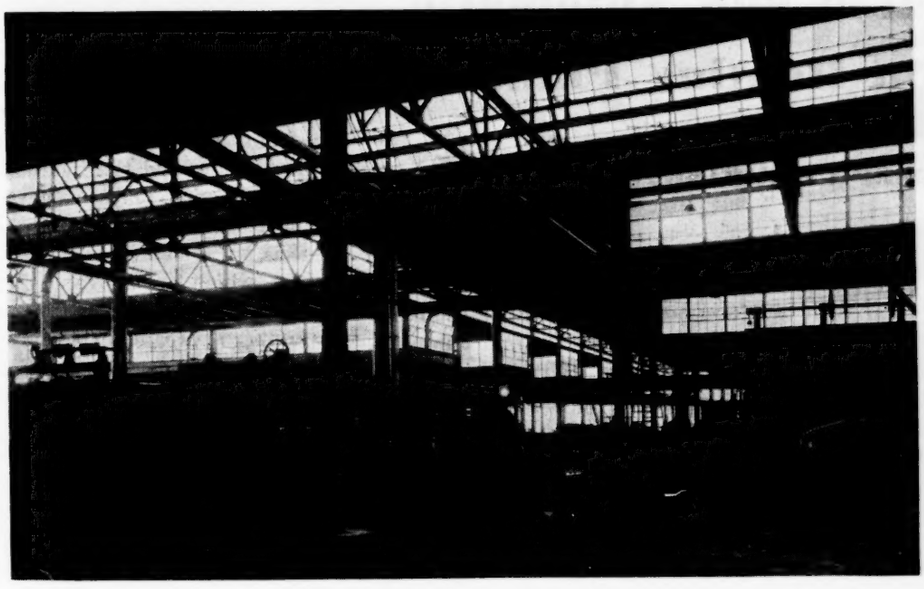
In the case of a fairly long building, it might be thought difficult to get good airation when the wind blows parallel to the long dimension and the monitor is also lengthwise of the structure. Under this condition, there is a strong suction, with consequent outflow, at both sides of the monitor near the windward end which decreases to zero farther downstream. Beyond this zero point, the air is flowing parallel to the monitor openings and whether air flows in or out of these downstream openings is determined by the demand for air at the outflow openings and the supply furnished by the windward inflow openings.

A suction is also created at the sides of the building near the windward end and, if there are comparatively few openings directly in the path of the wind for supply, the demand for air at openings in the suction areas will be greater than can be supplied by the windward windows. In consequence, air is drawn in through the openings located outside of the wind's influence and travels lengthwise of the building *toward the wind.* In the monitor, this means that air is sucked in at the sides downstream, travels down its length and out again near the windward end without much of this air reaching the breathing level. Not only is this short-circuiting of air of little benefit, but it clogs the upper openings, which should act as outlets to remove the air from below.

Air Movement Due to Temperature Difference

Almost everyone is familiar with the convection currents induced by the rise of warm and the fall of cold air.

The motive head, due to temperature difference, producing flow, is directly proportional to both the difference in temperature and the ver-



Interior View New Spring Plant, Detroit Steel Products Company, Looking Lengthwise from a Point Near Cross Monitor over Draw Furnaces

tical distance between inlet and outlet openings, and depends upon practically nothing else. The head, in feet of air, is determined by multiplying the vertical distance between upper and lower openings in feet by the difference in temperature between inside and outside air, and dividing by the average absolute temperature.

In order that there may be a flow of air due to temperature difference only there must be a difference in height between the inlet and outlet openings. While this fact is manifestly true, many building designs are found that depend for their ventilation on getting air in at certain openings, and out at other openings at just about the same level.

To compute the flow due to temperature difference, when inflow and outflow openings are of unequal area of resistance, there has been developed the important conception of the neutral zone. If air will flow in at certain openings because atmospheric pressure is greater on the outside, and out at certain other openings because atmospheric pressure is less, there is a point of equal atmospheric pressure somewhere between where the air will neither flow in nor out of an opening so located. This explains why high outflow openings and low inflow openings are more effective than openings situated near mid-height. The location of the neutral zone varies with the size and resistance of the inflow and outflow openings and its location is found in somewhat the way that the center of gravity of a section is obtained. Likewise the position of the neutral zone is used in computing flow in about the same way as we use the location of the center of gravity of a section in computing its moment of inertia.

In the summer advantage can usually be taken of the motive force of the wind and large volumes of air can be brought in to reduce the temperature difference, but the effective head due to temperature difference becomes materially less. In the winter the story is different, and in general the head created by temperature difference would be the chief motive force, since the inside air of an industrial building is considerably warmer than the outside air. This condition gives a head sufficient for all except the most extraordinary cases. Under winter conditions the pressure effect of the wind forcing air into a building would usually create too great a cooling effect and perhaps cause objectionable drafts.

The greatest flow in the summer will probably occur when all windows are open. The most effective flow, that is, through the breathing zone, will usually occur when all except the high window openings on the windward side are open. In the winter, the best air-rating conditions will occur when only the low openings on the windward or leeward side and the high openings in the leeward side are opened. If opening the low side wall windows should cause objectionable drafts or excessive cooling, then higher side-wall openings should be used for inflow openings. This will diminish the too great cooling effect that might occur with low incoming air, at the same time the decreased height between inlet and outlet openings will not decrease the head to such an extent that the air flow will not be sufficient.

Effect of Roof Shape

The shape of the roof, particularly that of the monitor roof, has little, if any, influence on the flow of air. Under the same conditions of wind and temperature difference, fenestration and dimensions, the suction created by one type of roof is no

(*Continued on Page* 118)

Fuel Selection and Automatic Stoking in Heating Plants

by **JOSEPH HARRINGTON**

ONE can get more heat on a price basis in the form of coal than with any other fuel, but the unavoidable presence of ash in coal, and its bulky nature, impose a responsibility upon the producers of coal and the manufacturers of mechanical stokers, to offset these disadvantages by developing stoking methods that will produce equally satisfactory results in the way of smokelessness, automatic control, and efficiency, when compared to gas or oil fuel.

Automatic stoking of coal, by which the maximum advantages of the fuel are obtainable, has taken tremendous strides within the past five years and today has reached a stage where highly efficient and otherwise satisfactory stoking is possible. From the standpoint of cost, it is a simple matter to figure the number of B.t.u. that can be secured for one cent in the various types of fuels, and it will be found that the owner can get from 60,000 to 80,000 B.t.u. for one cent as compared to 20,000 to 40,000 B.t.u. with gas or oil.

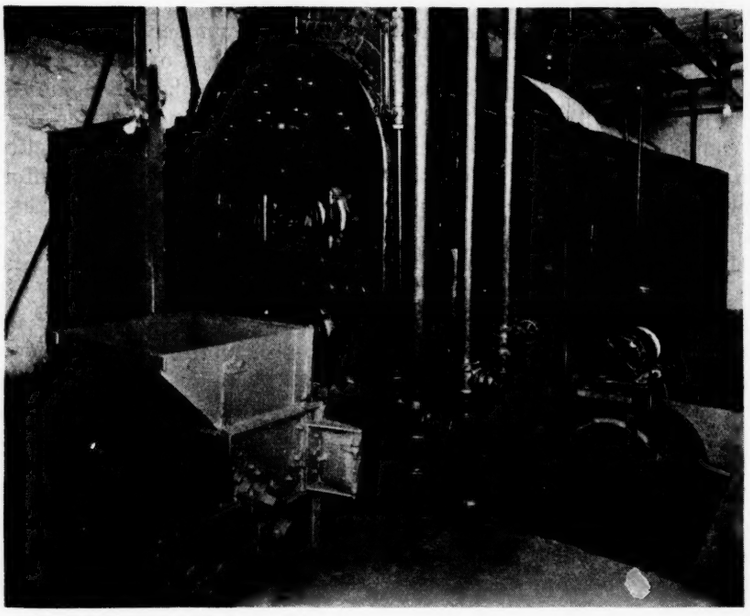
Heating plant stokers have followed power plant practice, most being of the underfeed type. With this type of stoker, coal is either pushed or screwed into a retort within the furnace, having substantially vertical sides and a row of air ports at the upper edge. Beyond these tuyeres at the sides of the retort, there is an extended area of grate surface, either dead plate, stationary grate bars, or some form of dumping or shaking grate. The coal is forced into the retort below the line of air admission, and it is this feature that gives it the name of underfeed stoker. The coal then passes vertically upward into the line of air admission and ignites. The entire mass is rapidly ignited and burns fiercely under the influence of the high velocity air jets emerging from the tuyeres.

Above the retort the fuel piles up to an extent determined by the character of the secondary grate surface. If there is no movement to this surface, the coal piles up until it flows down the side of the mound under the influence of gravity. If the additional area is formed of movable grate bars then the pile is not so high but is mechanically extended laterally to the side dump or dead plates.

This type of stoker, while desiring a high fusing-point ash, rather avoids the coking types because of the tendency of the entire fuel mass to consolidate during the period when the blast is shut off, due to high steam pressure, automatic control being the rule.

The other principal type of automatic stoker is the overfeed, which classification has two sub-divisions: The front horizontal grate without gravity action, and the inclined type wherein gravity plays a part. In the horizontal type, the stoker is formed of a series of grate sections, some of which are movable in such a manner that the fuel is taken from the hopper, spread out evenly over the grate surface and pushed along the grate, while undergoing combustion, until the rear of the stoker is reached, at which point combustion is completed and the ash is continuously and automatically rejected to the pit. Any form of coal can be burned on this type of stoker without the formation of clinkers, due to the principle of progressive combustion and automatic removal of ash.

The last type of stoker to be considered is the inclined gravity type wherein the grate surface is tilted up at an angle and provided with movable sections which are automatically or manually moved at certain intervals. The motion of these grate sections urges the fuel forward by the aid of gravity, causing a progression from the point of entrance at the front, to a hand-operated dump plate at the rear. These stokers will burn any coal but those with high fusing-point ash result noticeably in less clinker formation and dump plate difficulty.



Stoker Firing a Down-Draft Steel Boiler in Shoe Factory

Firing Steam Boilers with Oil

by **HARRY E. GILBERT**

A NOTABLE example of the radiant method of boiler firing using oil fuel is that in the plant of the Sikorsky Aviation Corporation, Stratford, Conn.

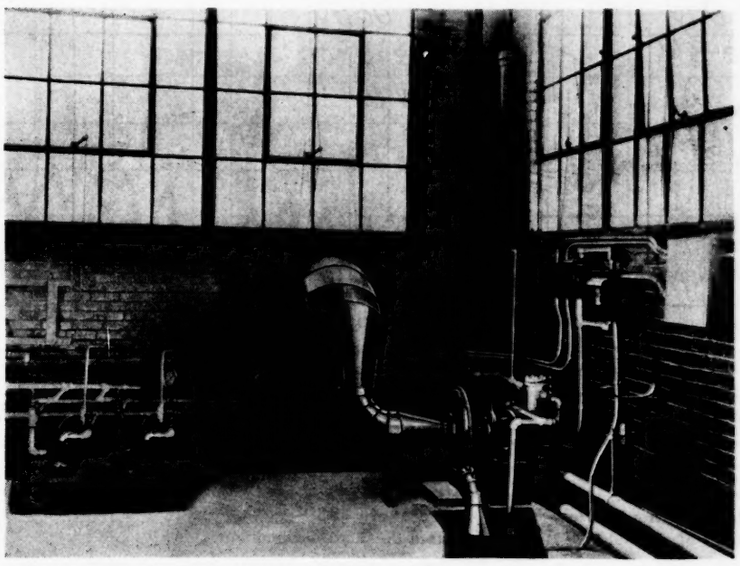
The heating plant is located in one corner of the building. Originally, one of the conventional types of oil burners was installed, which, under the conditions, failed to perform in a satisfactory manner, and it was judged that one of the underlying reasons for the failure was the stack which was carried up only a short distance beyond the square of the building.

However, although this stack remains practically the same as originally built, the present installation not only meets the normal conditions, but provides a reserve to meet unusual conditions and meets them when they do exist. Consequently, it is plain that the trouble with the previous installation of the burners of conventional type was not in the stack, but in the other features common to all ordinary methods and systems, regardless of the type of burner employed.

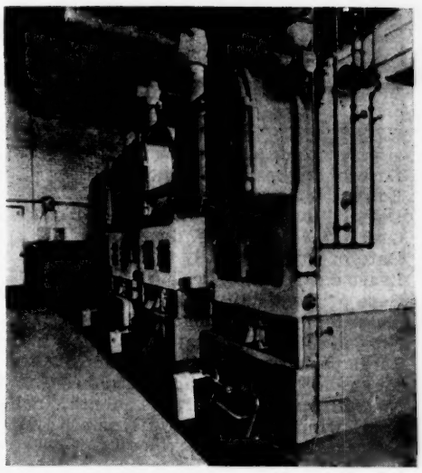
The radiant method is patented and is a development of the ideas embodied in preceding patents covering radiant combustion applied to industrial purposes with both oil fuel and gas fuel.

The oil pumps are of the simple rotary type, direct connected to small, compact motors, each capable of carrying the full load at any and all times.

One of the distinguishing features in this installation is a dependable and flexible air blower. It is direct connected to a 5 hp. motor. At one time, only one out of three of the 150 hp. boiler units may be operated at as low as 25% of rating, while at another time all three of the 150 hp. units may be operated at 200% of rating. The fan has a cast housing with the rotor on an over-hung shaft, with no bearings as a part of the blower unit itself.



Blower and Pumps in Sikorsky



Three Boiler Unit in Sikorsky

As with every item of equipment comprising this system for oil fuel, the blower is not special. All standard stock items are used. The automatic features of this system are equally simple and standardized.

As the oil fuel leaves the burner, it is atomized and gasified by passing between surfaces of highly conducting heat-accumulating refractories. The resultant state of combustion, termed by the originator as combustion in suspension is highly developed and the flame temperature is at a maximum, based on the ultimate heat value of the oil fuel itself.

The completed combustion, carrying forward the products of combustion, passes over a floor or sloped inlay to the water containing parts of the boiler and is there absorbed and converted into steam.

That the combustion is complete is evidenced by the fact that the surrounding brick walls or fire box lining are not stressed in the least, regardless of the extent to which the firing is forced and no unusual care or attention is needed in the maintenance of the fire box.

Safety Code for Refrigeration Equipment Adapted by A.S.A.

A national safety code for mechanical refrigerators of all types, including cooling systems for theatres and other buildings, has been approved by the American Standards Association. The code was prepared under the direction of the American Society of Refrigerating Engineers, with 43 national organizations cooperating, among them being the A.S.H.V.E. and A.S.M.E. The code applies to both direct and indirect methods of circulating the brine or refrigerant.

Copies of the code can be secured from the American Standards Association, 29 West 39th St., New York, at 30 cents per copy.

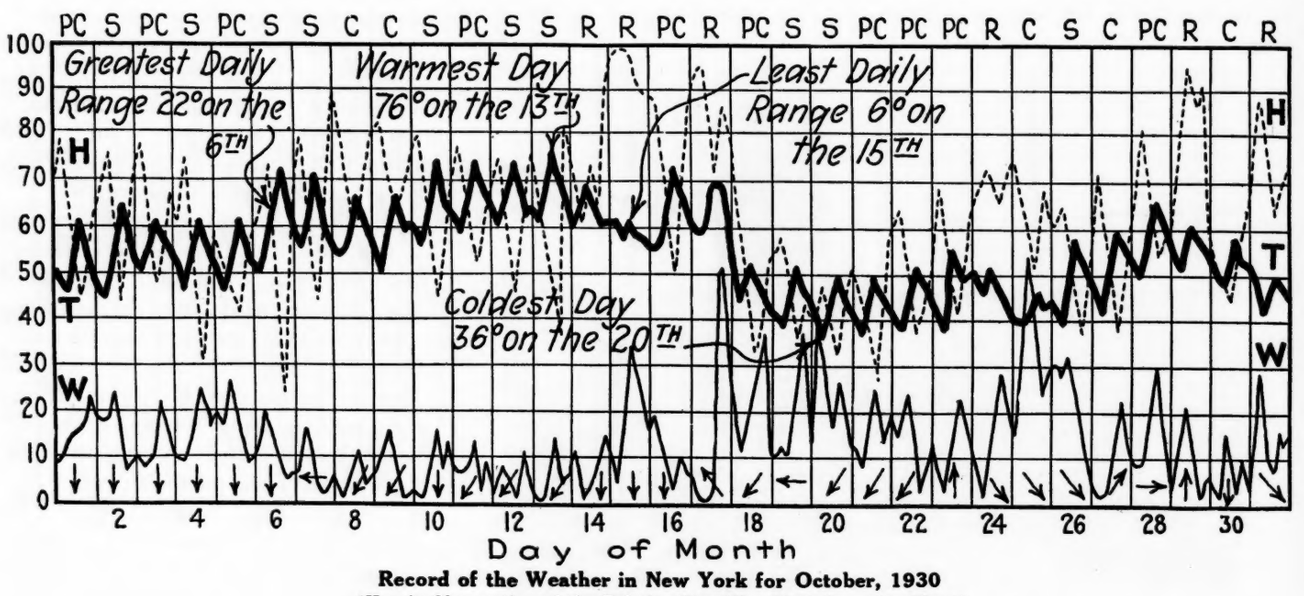
Peirce D. Schenck

Peirce D. Schenck, president of the Duriron Co., Inc., Dayton, O., died on October 15.

Mr. Schenck, who was a graduate of Sheffield Scientific School, Yale University, was president of the Duriron Company since its inception fifteen years ago.

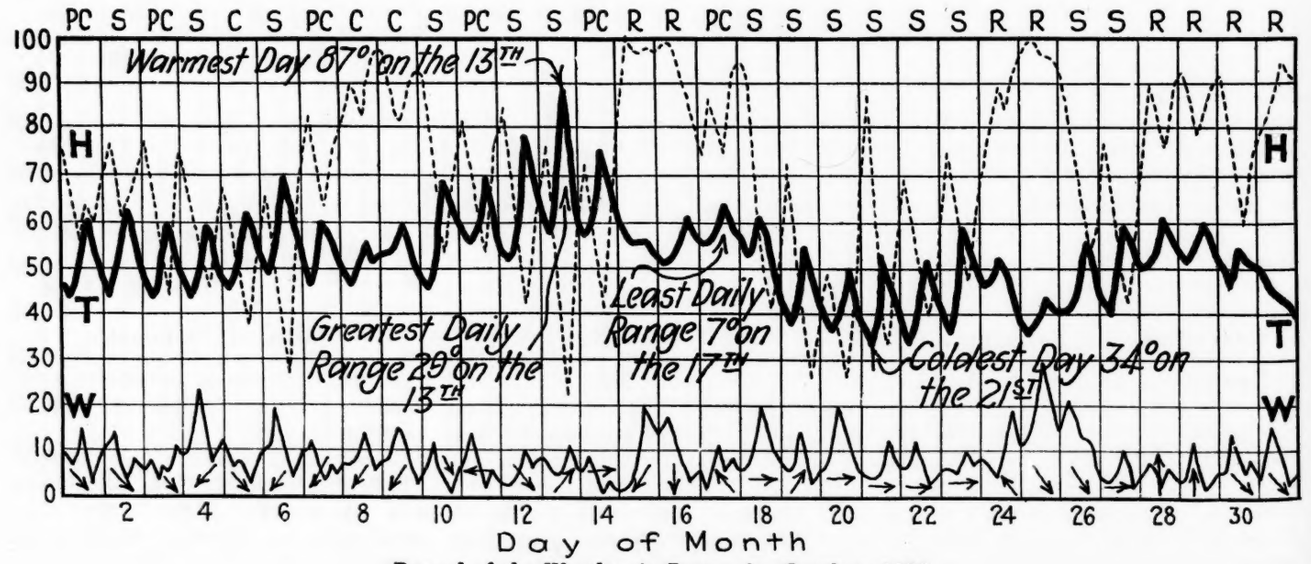
The Weather for October, 1930

	New York	Boston	Pittsburgh	Chicago	St. Louis
Highest temperature, deg. F.	76	87	82	80	84
Date of highest temperature	13	13	13	10	10
Lowest temperature, deg. F.	36	34	26	24	31
Date of lowest temperature	20	21	20	20	31
Greatest daily range, deg. F.	22	29	31	27	30
Date of greatest daily range	6	13	6	26	16
Least daily range, deg. F.	6	7	6	2	4
Date of least daily range	15	17	18	7	22
Mean temperature for month, deg. F.	55.0	53.0	52.4	51.6	57.1
Normal mean temperature for month, deg. F.—	56.3	53.6	55.6	54.0	58.8
Total precipitation, this month, inches	1.76	5.83	1.17	2.81	1.84
Total snowfall, this month, inches	None	Trace	Trace	Trace	Trace
Normal precipitation, this month, inches	3.53	3.15	2.52	2.53	2.72
Total wind movement, this month, miles	9058	5520	5477	6186	7144
Average hourly wind velocity, miles	12.2	6.4	7.4	8.3	9.6
Prevailing direction of wind	N.	N.W.	W.	N.W.	S.
Number of clear days	10	13	13	10	18
Number of partly cloudy days	11	8	7	12	4
Number of cloudy days	10	10	11	9	9
Number of days with precipitation	8	10	8	7	6
Number of days with snowfall	None	None	None	None	None
Snow on ground, at end of month	None	None	None	None	None

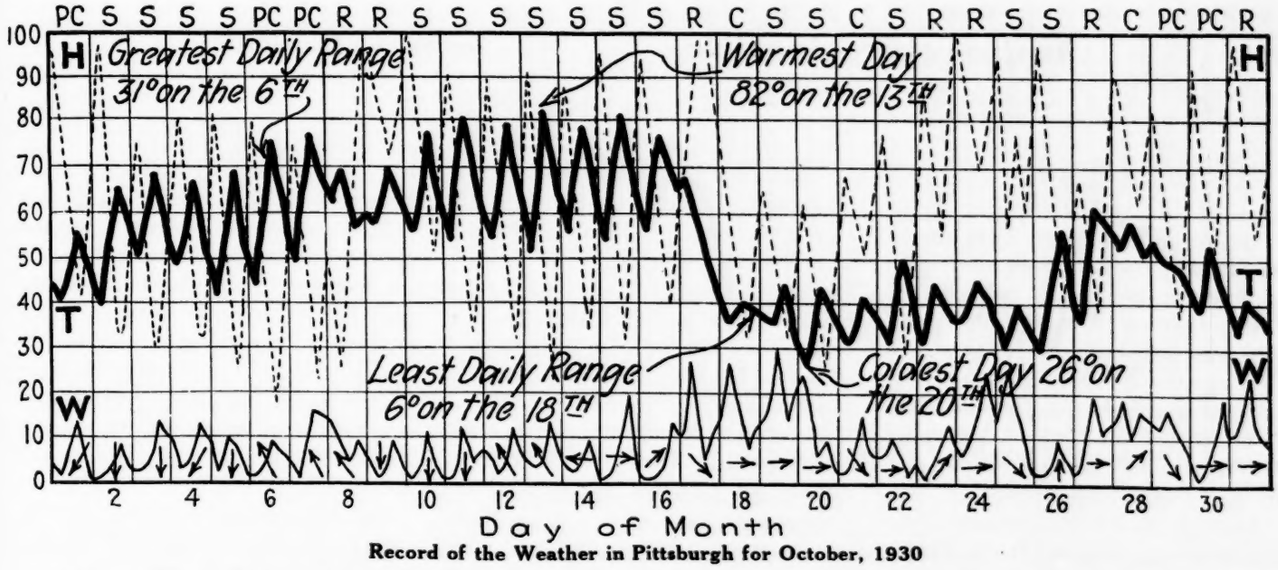

PC S PC S PC S S C C S PC S S R R PC R PC S S PC PC PC R C S C PC R C R
Greatest Daily Range 22° on the 6TH
Warmest Day 76° on the 13TH
Least Daily Range 6° on the 15TH
Coldest Day 36° on the 20TH
H
T
W
100 90 80 70 60 50 40 30 20 10 0
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
Day of Month

Record of the Weather in New York for October, 1930

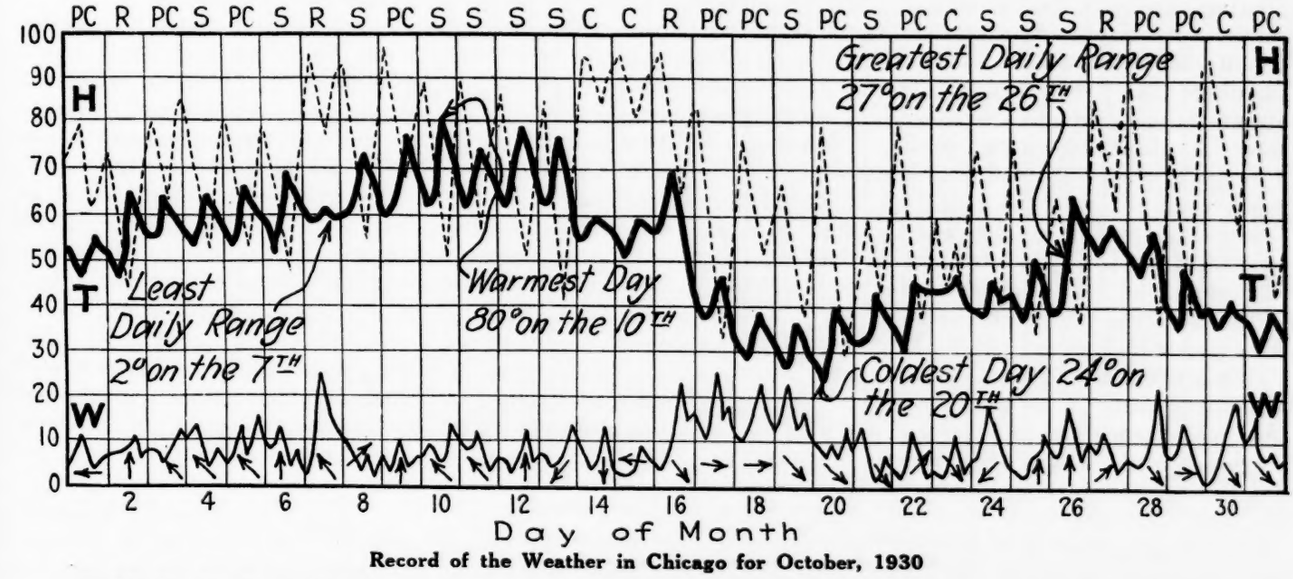
(Hourly Observation of the Relative Humidity Plotted on this Chart)


PC S PC S C S PC C C S PC S S PC R R PC S S S S S S R R S S R R R R
Warmest Day 87° on the 13TH
Greatest Daily Range 29° on the 13TH
Least Daily Range 7° on the 17TH
Coldest Day 34° on the 21ST
H
T
W
100 90 80 70 60 50 40 30 20 10 0
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
Day of Month

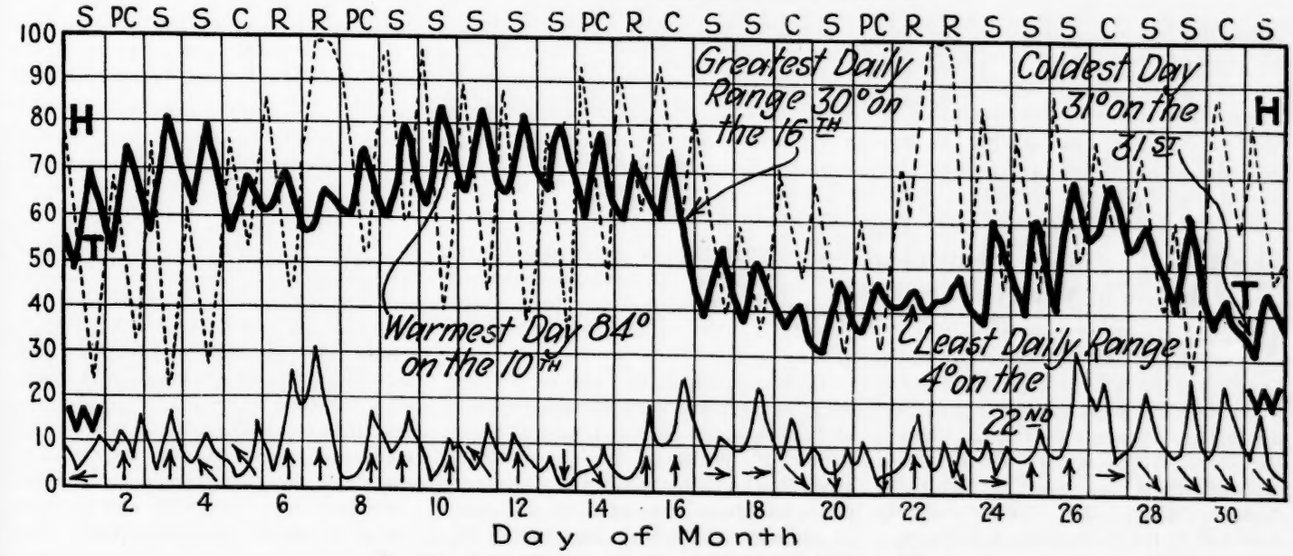
Record of the Weather in Boston for October, 1930


PC S S S S PC PC R R S S S S S S S R C S S C S R R S S R C PC PC R
Greatest Daily Range 31° on the 6TH
Warmest Day 82° on the 13TH
Least Daily Range 6° on the 18TH
Coldest Day 26° on the 20TH
H
T
W
Day of Month

Record of the Weather in Pittsburgh for October, 1930


PC R PC S PC S R S PC S S S S C C R PC PC S PC S PC C S S S R PC PC C PC
Greatest Daily Range 27° on the 26TH
Least Daily Range 2° on the 7TH
Warmest Day 80° on the 10TH
Coldest Day 24° on the 20TH
H
T
W
Day of Month

Record of the Weather in Chicago for October, 1930


S PC S S C R R PC S S S S S PC R C S S C S PC R R S S S C S S C S
Greatest Daily Range 30° on the 16TH
Coldest Day 31° on the 31ST
Warmest Day 84° on the 10TH
Least Daily Range 4° on the 22ND
H
T
W
Day of Month

Record of the Weather in St. Louis for October, 1930

Plotted from records especially compiled for HEATING AND VENTILATING by the United States Weather Bureau.
Heavy lines indicate temperatures in degrees F. Light lines indicate wind in miles per hour.
Broken lines indicate humidity in percentage from readings at 8 A.M., 12 M., and 8 P.M. Arrows fly with prevailing directions of wind.
S—clear, PC—partly cloudy, C—cloudy, R—rain, Sn—snow.

Industrial Airation

by **W. C. Randall**

(*Continued from page* 113)

more effective than that created by another. In other words, certain forms of roofs that are recommended as cure-alls really depend on the size, orientation, height above inlets, etc., rather than on the roof design itself. The only factors influencing the airation are the size and location of the window opening, velocity and direction of the wind, the temperature difference and the height between inlet and outlet openings.

Louvers, roof ventilators, etc., have for their motive heads the same ventilating forces as do windows. In adjacent locations and under similar conditions, measurements on actual buildings have shown that the velocity of air flow through a roof ventilator is about the same as that through a window. In other words, when conditions are the same, the velocity of air flow is practically independent of the type of opening. Therefore, the volume of air moved will be determined by the opening area provided.

When furnaces or other heat processes are located in the leeward end, the smoke and gases are sometimes drawn down the length of the building through the working zone before they can make their exit. This difficulty can be avoided while the building is in the planning stage by changing the orientation, by locating the furnaces at the windward end or by providing cross monitors or a higher portion over the furnaces so that the wind may strike it and create suction areas at the lee side to draw out the smoke and fumes. In existing buildings, this difficulty may be overcome by closing windows in the suction zone at the windward end of the monitor, thus allowing the wind to blow straight through and assist the flow due to temperature difference in taking the air out over the furnaces.

The new Spring Plant of the company with which the writer is associated is of interest since it incorporates in the design certain fundamentals for adequate and controlled airation as well as adequate uniform daylighting. Features of the design that might be noted are:

(a) Equal areas of windows perpendicular and parallel to the longitudinal axis of the building.

(b) Windows higher from the floor at the longitudinal monitor and in the cross monitor over the heating furnaces.

(c) Window areas approximately 45% of the floor area and ventilating area approximately 25% of the floor area.

The fenestration was designed to give a flow of about 2,000,000 cu. ft. of air per min. due to the combined heads created by a five mile breeze and the temperature difference, and maintain a maximum temperature difference of 15° at the working zone around the furnaces and the outside air. While this plant has never been in full production, tests at the plant indicate that our computations were reasonably accurate and, if anything, conservative. Only on the hottest days (95° or above) and in a small percentage of the working space (for instance between the draw furnaces, and in the forge department where the men were surrounded by red hot material in process) was it found desirable to use a 12-in. electric fan.

Fig. 1 is an inside view looking lengthwise of the plant from a point near the cross monitor. It gives a fair idea of the structural design and the window layout.

The advantages from an airation standpoint that would be gained from such a design are:

(1) There will always be openings in the lee or jump of the wind regardless of its direction, which can be opened for outflow and there will be windows on the windward side which can be opened for inflow.

(2) Air can be brought in at almost any desired point, carried through the building and taken out at other convenient points, giving an actual and controlled airation.

(3) The design provides for extreme flexibility and permits a wide range of air movement with either an extremely large or an extremely small number of air changes per hour.

(4) The two forces, wind and temperature difference, can be coordinated and controlled to work together rather than at cross purposes.

(5) Practically any desired number of windows can be hooked up together for mass operation, or any desired window, bay or section can be arranged for individual operation.

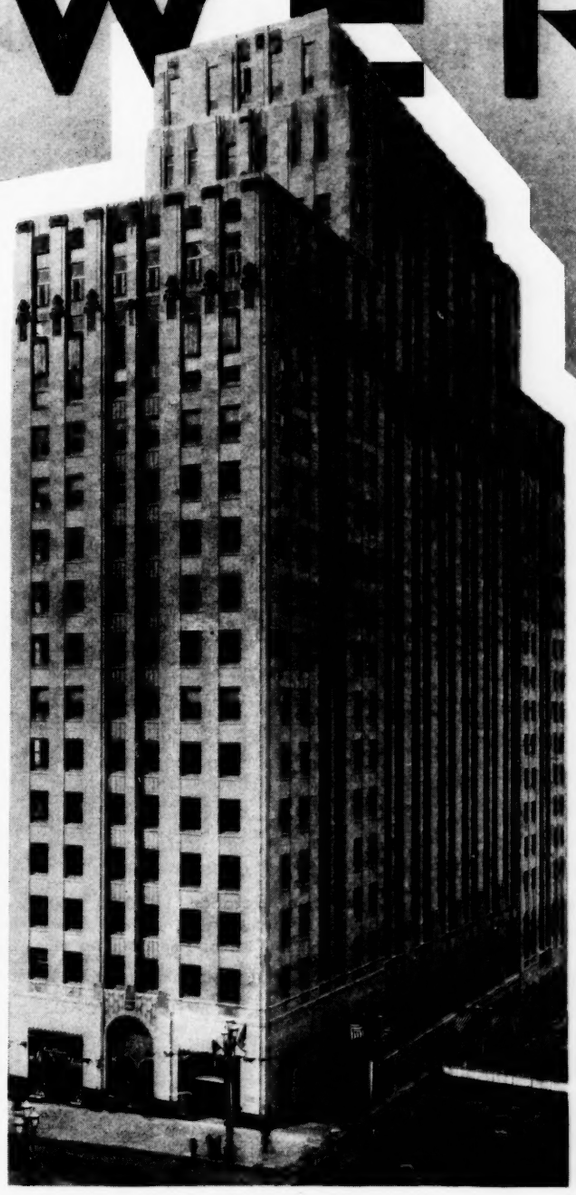
Christy to Head Smoke Abatement Bureau in New Jersey

William G. Christy, mechanical engineer of the Board of Education of St. Louis, has been appointed engineer in charge of the newly organized Smoke Abatement Bureau of Hudson County, New Jersey. The bureau will be a new department of the Board of Health of Hudson County. Mr. Christy recently returned to St. Louis after a conference with Mayor Frank Hague of Jersey City, N. J., John F. O'Neill, president of the Board of Freeholders of Hudson County, and Dr. Harvey N. Davis, president of Stevens Institute of Technology, Hoboken, N. J. Mr. Christy will take office December 1.

The smoke campaign will be conducted in cooperation with Stevens Institute of Technology at Hoboken, where Colonel Elliott H. Whitlock, for the past six years Smoke Commissioner of Cleveland, Ohio, has been appointed to the chair of Smoke Abatement Research. Mr. Whitlock will coordinate all smoke activities in various counties and municipalities of New York, New Jersey and Connecticut with the smoke abatement campaign in New York City.

Hudson County is appropriating $40,000 for the first year's work. Mr. Christy will have full charge of the campaign, the budget for 1931 providing also for a deputy engineer and six smoke inspectors. Hudson County comprises the territory across the Hudson River from New York City and includes a total of fourteen municipalities. This is the first time in this country that a county has set up a smoke department.

POWERS

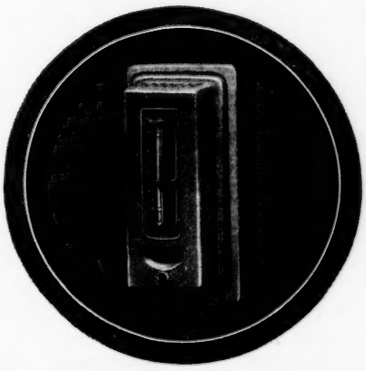


THE EXCHANGE BUILDING IN SEATTLE

Architect
John Graham

Engineer
C. H. Knowles

Heating Contractor
The Rautman Plumbing and Heating Co.



Powers Thermostats Are Better

Because—they often give 15 to 25 years of accurate control without repairs of any kind—need no annual adjustment or overhauling—and have no fine restrictions to become clogged by dirt.

Here is another prominent building equipped with the Powers System of Automatic Temperature Control.

Wherever Quality is the chief consideration, you will invariably find the heating and ventilating system regulated by Powers control.

Its first cost is usually higher, but it costs less in the end because: it often gives 15 to 25 years of Accurate and Dependable control with practically no expense for repairs.

THE POWERS REGULATOR COMPANY

35 Years of Specialization in Temperature Control

CHICAGO, 2718 Greenview Ave. NEW YORK, 137 E. 46th Street

Offices in 37 other cities

Degree-Days and Unit Fuel Consumption in Typical Cities for October

UNIT fuel consumption figures given below must be corrected for efficiency, heat content of fuel other than that listed below, for radiation emitting other than 240 B.t.u. per hr., and for radiation calculated on a basis of other than zero to 70°.

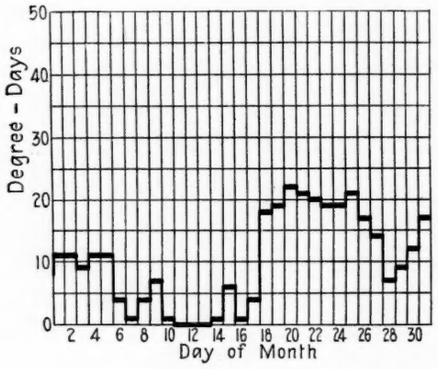
Coal is assumed as having a heat content of 12,000 B.t.u. per lb., gas, 1000 B.t.u. per cu. ft., and oil 140,000 B.t.u. per gal. To correct for other heating values, multiply the fuel consumption listed under the charts by the standard heat content just listed, and divide by the heat content in question.

To correct for efficiency, divide the fuel consumption by the efficiency of the heating installation.

For water radiation, multiply the fuel consumption, which is given for steam radiation, by 5/8.

For radiation installed for any other outside temperatures than zero, multiply the fuel consumption given under the charts by 70°, divided by the quantity (70 minus the outside temperature used).

	Los Angeles	Baltimore	Philadelphia	New Orleans	Atlanta	Cleveland	Cincinnati	Detroit
Degree-Days	19	257	272	35	187	403	367	425
Lbs. of Coal per Sq. Ft. of Radiation for October, 1930	0.152	2.056	2.176	0.280	1.496	3.224	2.936	3.400
Gals. of Oil per Sq. Ft. of Radiation for October, 1930	0.013	0.176	0.187	0.024	0.128	0.276	0.252	0.291
Cu. Ft. of Gas per Sq. Ft. of Radiation for October, 1930	1.82	24.67 (See Footnote)	26.11	3.36	17.95	38.69	35.23	40.80



New York, October, 1930

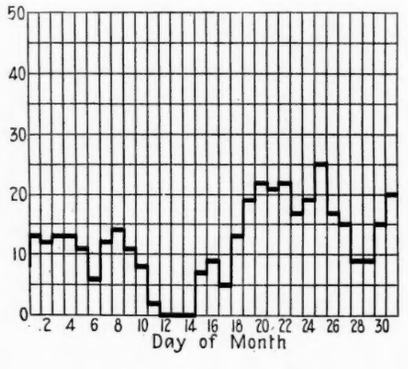
Degree-Days 317—to Date, 329

Lbs. of Coal per Sq. Ft. of Radiation for this Month, 2.536

Gals. of Oil per Sq. Ft. of Radiation for this Month, 0.217

Cu. Ft. of Gas per Sq. Ft. of Radiation for this Month, 30.43

(See Footnote)



Boston, October, 1930

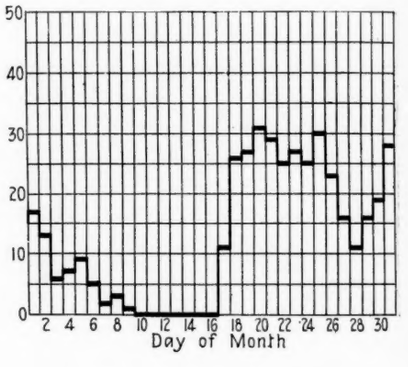
Degree-Days 379—to Date, 407

Lbs. of Coal per Sq. Ft. of Radiation for this Month, 3.032

Gals. of Oil per Sq. Ft. of Radiation for this Month, 0.260

Cu. Ft. of Gas per Sq. Ft. of Radiation for this Month, 36.38

(See Footnote)



Pittsburgh, October, 1930

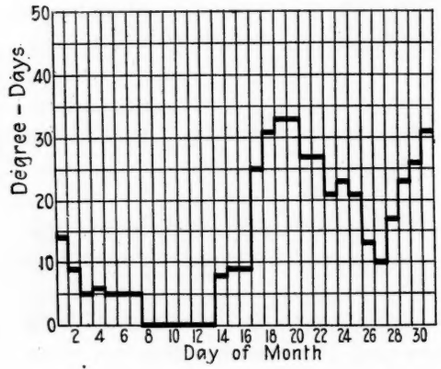
Degree-Days 407—to Date, 448

Lbs. of Coal per Sq. Ft. of Radiation for this Month, 3.256

Gals. of Oil per Sq. Ft. of Radiation for this Month, 0.279

Cu. Ft. of Gas per Sq. Ft. of Radiation for this Month, 39.07

(See Footnote)



Chicago, October, 1930

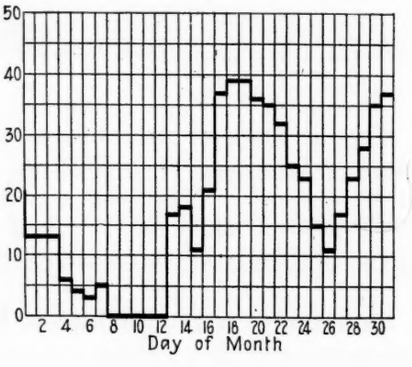
Degree-Days 436—to Date, 502

Lbs. of Coal per Sq. Ft. of Radiation for this Month, 3.488

Gals. of Oil per Sq. Ft. of Radiation for this Month, 0.299

Cu. Ft. of Gas per Sq. Ft. of Radiation for this Month, 41.86

(See Footnote)



Minneapolis, October, 1930

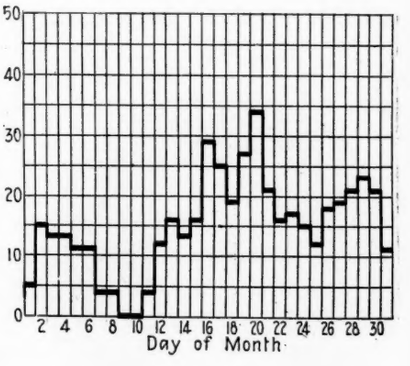
Degree-Days 556—to Date, 701

Lbs. of Coal per Sq. Ft. of Radiation for this Month, 4.448

Gals. of Oil per Sq. Ft. of Radiation for this Month, 0.381

Cu. Ft. of Gas per Sq. Ft. of Radiation for this Month, 53.38

(See Footnote)



Denver, October, 1930

Degree-Days 465—to Date, 545

Lbs. of Coal per Sq. Ft. of Radiation for this Month, 3.720

Gals. of Oil per Sq. Ft. of Radiation for this Month, 0.319

Cu. Ft. of Gas per Sq. Ft. of Radiation for this Month, 44.64

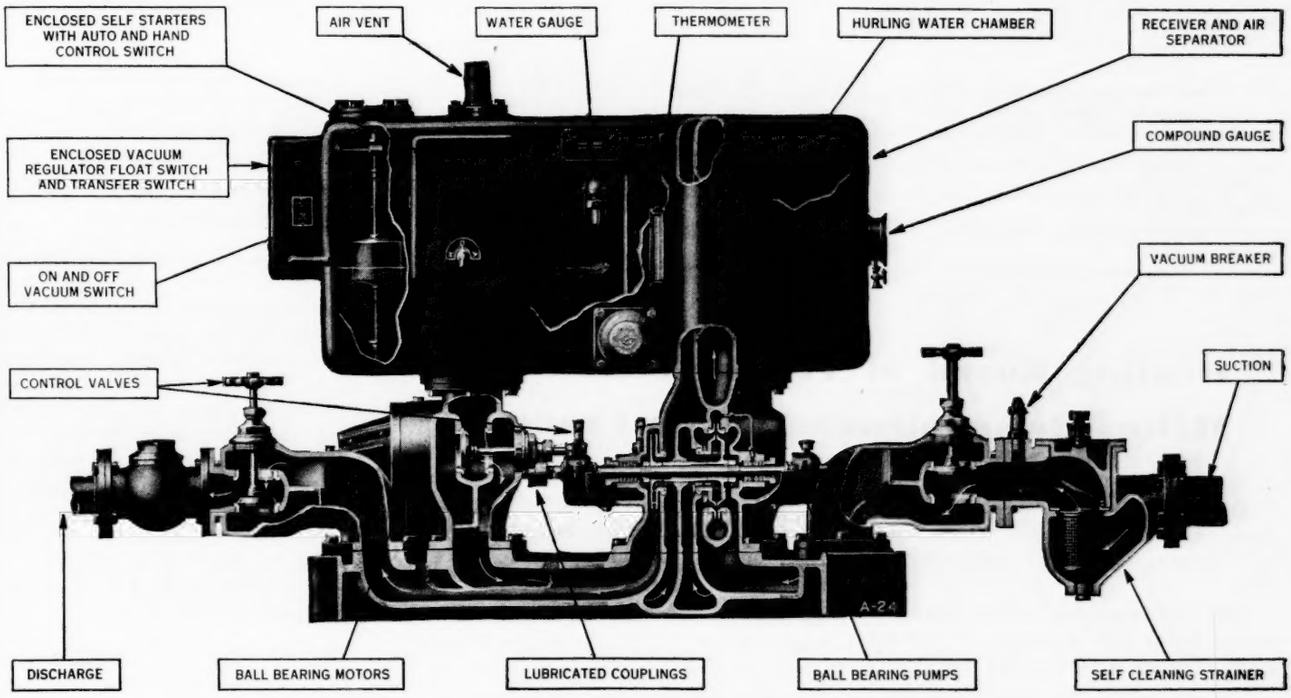
(See Footnote)

These figures must be corrected for local conditions as explained above.

(Continued on page 122)

By all means *COMPARE!*

THE AMES VACUUM HEATING PUMP



MAKE THE comparison complete, based solely on the heating system problem and the ability of the pump to solve that problem.

Comparisons such as this reveal the value of the AMES Pump and emphasize the fact that it is

The Pump of Performance

AMES PUMP COMPANY, INC.

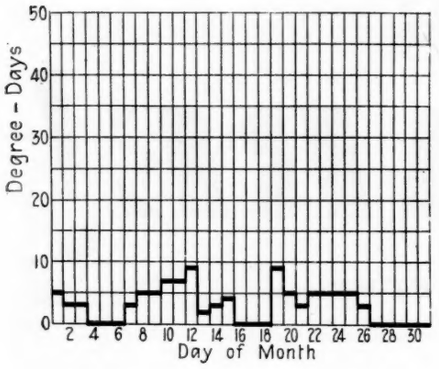
30 Church Street • New York City

Affiliated with **AMERICAN LOCOMOTIVE COMPANY**

PERFORMANCE DISTINCTIVELY DIFFERENT

Degree-Days for October, 1930

(*Continued from page* 120)



San Francisco, October, 1930

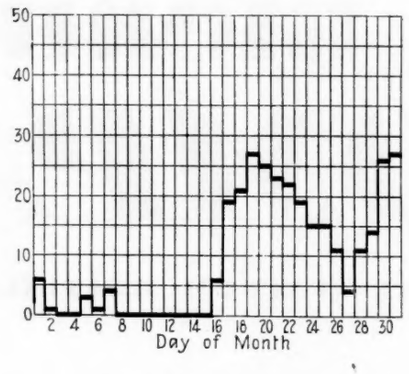
Degree-Days 96—to Date, 176

Lbs. of Coal per Sq. Ft. of Radiation for this Month, 0.768

Gals. of Oil per Sq. Ft. of Radiation for this Month, 0.066

Cu. Ft. of Gas per Sq. Ft. of Radiation for this Month, 9.22

(*See Footnote, page* 120)



St. Louis, October, 1930

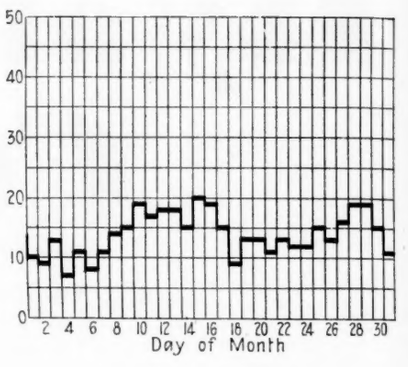
Degree-Days 300—to Date, 305

Lbs. of Coal per Sq. Ft. of Radiation for this Month, 2.400

Gals. of Oil per Sq. Ft. of Radiation for this Month, 0.206

Cu. Ft. of Gas per Sq. Ft. of Radiation for this Month, 28.80

(*See Footnote, page* 120)



Seattle, October, 1930

Degree-Days 430—to Date, 607

Lbs. of Coal per Sq. Ft. of Radiation for this Month, 3.440

Gals. of Oil per Sq. Ft. of Radiation for this Month, 0.295

Cu. Ft. of Gas per Sq. Ft. of Radiation for this Month, 41.28

(*See Footnote, page* 120)

Heating Board of Trade Committee Makes Recommendations on Credits

At the November meeting of the Heating Board of Trade of New York, the Credit Committee recommended that:

"All invoices shall state the true dates, terms and amounts of transactions covered by the same.

"On or before the.....of each month all members shall file with the secretary a complete list of all accounts, giving names and amounts, owing for .....days or more, and shall also promptly notify the secretary when any of the said accounts have been paid, whereupon the list shall be revised accordingly.

"The secretary shall promptly compile the list of such accounts and mail the same to all members, and promptly notify all members of any changes or revisions in said list."

The committee, composed of A. P. Keasbey, B. W. Bennett, M. M. Goldsmith, P. W. Norby, H. Sleik, and R. A. Wolfe, stated in its report that the heating and ventilating industry is peculiarly susceptible to laxity in the matter of unduly and unreasonably extending credit for the purchase of materials and equipment. Abstracts from the report follow:

The constant accumulation of uncollectible accounts, through extension of credit to those financially and otherwise not responsible, and at the same time causing the duplication and multiplication of overdue bills, is not in public interest. The resulting condition is thoroughly unhealthy from every standpoint.

Healthy competition, which makes for efficient service to the public, requires that sellers, buyers and contractors be put upon a common ground of equality in all respects. The buyer or contractor, as the case may be, should not be penalized for the prompt payment of all bills when due, especially when in competition with another who undersells or underbids with no thought or ability of promptly meeting his commitments.

The committee does not contemplate the making of any recommendations which would conflict with principles of equality between and among sellers and buyers and contractors, large or small, or which would not be consistent with high standards of commercial conduct. Equal emphasis should be laid upon protecting the speculator in this industry, when he is bidding for a contract or buying materials and equipment, against his own folly, as well as protecting the manufacturer and seller and insuring payment for goods sold and services rendered. The announcement of these principles should lead to the conviction independently arrived at that custom establishes fair and reasonable terms, that the equality of buyers should not be disturbed by giving better terms to some than to others.

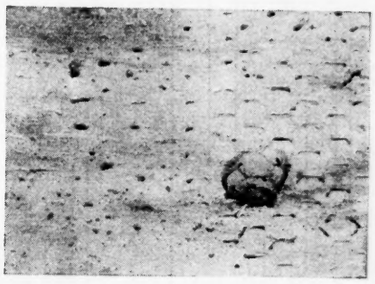
The character of the heating and ventilating industry is such that it is difficult for those engaged in it to obtain promptly reliable and dependable data and information concerning the financial responsibility of purchasers. The amount of dollars involved is large, the number of purchasers and contractors is also very large and the method of carrying on the business is not entirely conducive to stability or constant and dependable credit ratings.

A.S.A. Approves Coal and Coke Testing Methods

The American Standards Association has approved the American Standard methods of laboratory sampling and analysis of coal and coke submitted by the American Society for Testing Materials, which is the proprietary sponsor for the project under A.S.A. procedure.

These methods were originally prepared by joint committees of the American Society for Testing Materials, American Chemical Society, and the American Foundrymen's Association. The recent revisions of the methods consist of minor changes in some of the methods of test and do not radically alter any of the procedures. These changes are the result of investigations of the methods of analysis with a view of increasing their accuracy. Many of the determinations made in analyzing coal and coke are in part empirical in nature and methods of this character require close standardization to secure good agreement between different laboratories.

BI-FLAX

the only Insulating Plaster Base that provides a *Mechanical Key* for the  plaster

By permanently combining FLAX-LI-NUM with diamond mesh metal lath, BI-FLAX, the first insulating plaster base of steel, provides a positive mechanical key for plaster. It prevents the development of ugly cracks and blemishes. It protects against age as well as heat and cold.

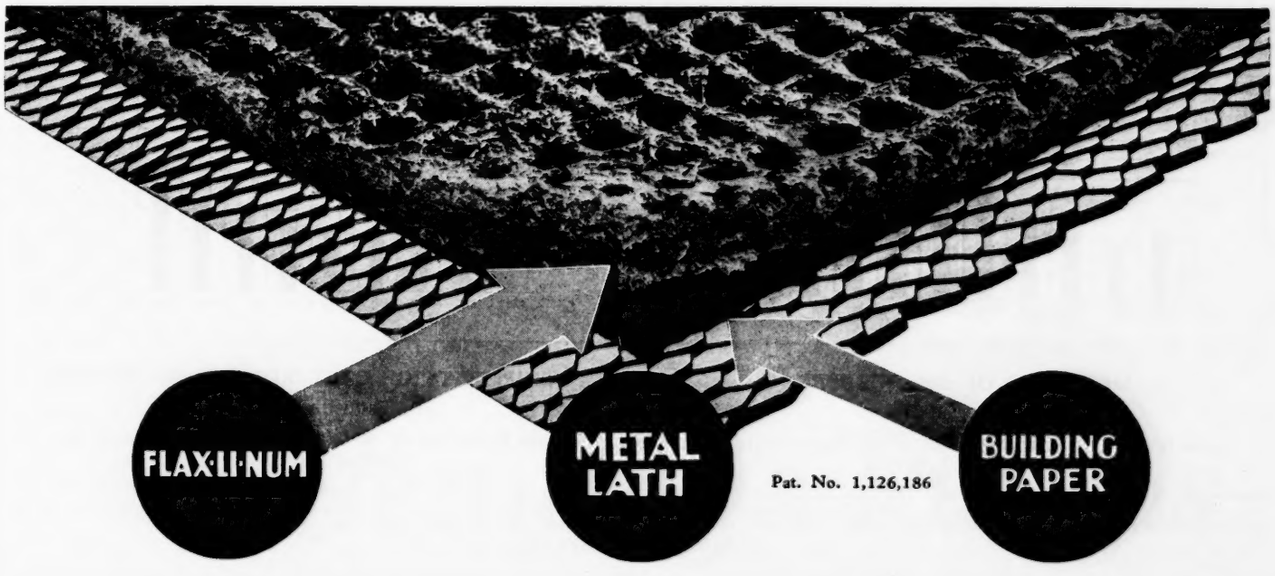
Because of the definite trend toward a "mechanical" plaster key, BI-FLAX has been pronounced one of the greatest advances ever made in the science of home insulation. It solves a most difficult problem . . . that of economically building life time beauty and comfort into a home with a single material.

A sample of BI-FLAX and complete information for your files will be sent upon request.

A Product of

FLAX-LI-NUM INSULATING COMPANY

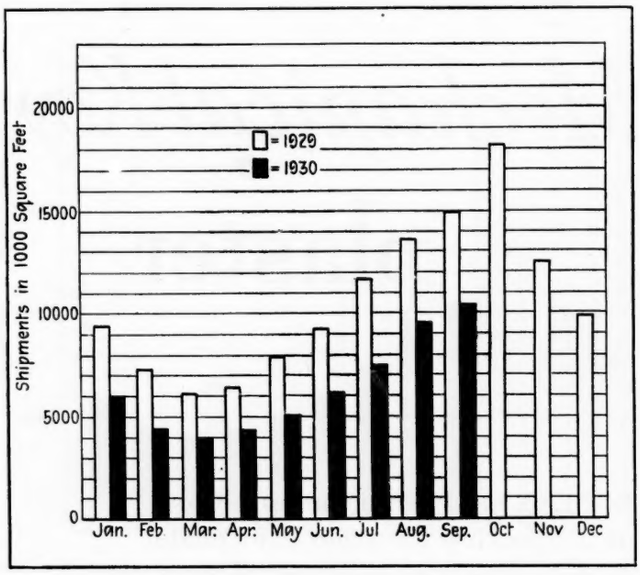
ST. PAUL, MINN.



HEATING AND VENTILATING

Statistical Service

Based on Data Supplied by the Department of Commerce

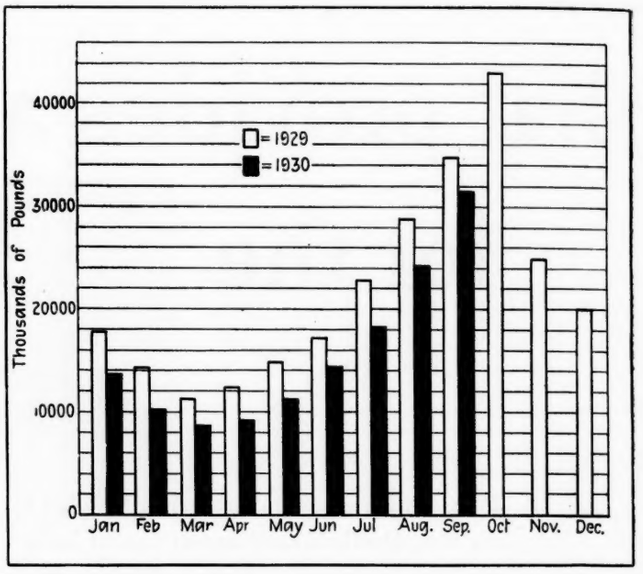


SHIPMENTS OF CAST-IRON RADIATORS

(In 1000 Square Feet)

As Reported by 15 Manufacturers Representing over 90% of the Industry

September, 1930, 10,347; September, 1929, 14,980; decrease over last year, 31%; total for nine months, 1930, 57,166; for nine months, 1929, 86,782; decrease over last year, 34.6%.

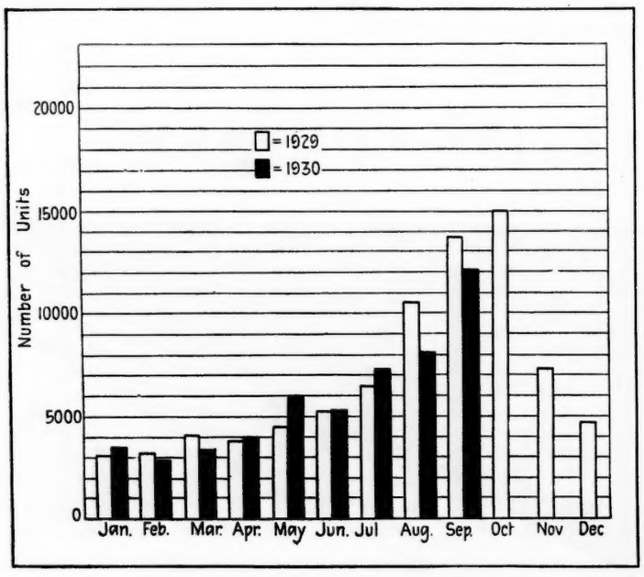


SHIPMENTS OF CAST-IRON SQUARE BOILERS

(In Thousands of Pounds)

As Reported by 25 Manufacturers Representing 90% of the Industry

September, 1930, 31,595; September, 1929, 34,761; decrease over last year, 9.1%; total for nine months, 1930, 141,989; total for nine months, 1929, 174,746; decrease over last year, 18.7%.

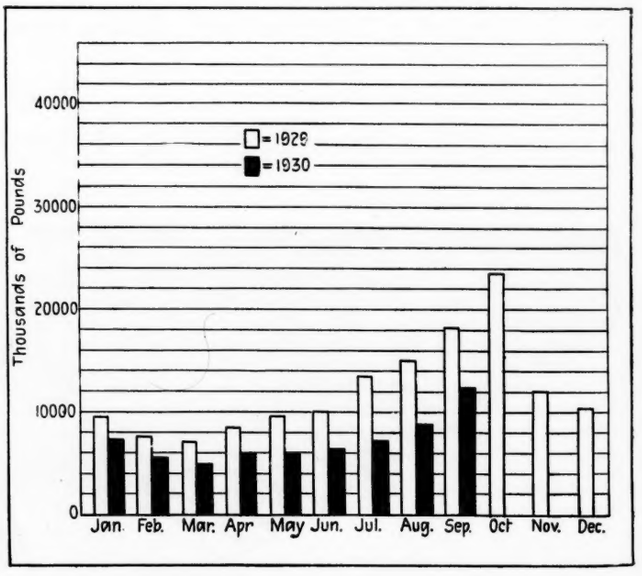


SHIPMENTS OF OIL BURNERS

(In Number of Units)

As Reported by 50 Manufacturers Representing 60% of the Industry

September, 1930, 12,025; September, 1929, 13,723; decrease over last year, 12.4%; total for nine months, 1930, 52,151; total for nine months, 1929, 54,716; decrease over last year, 4.7%.



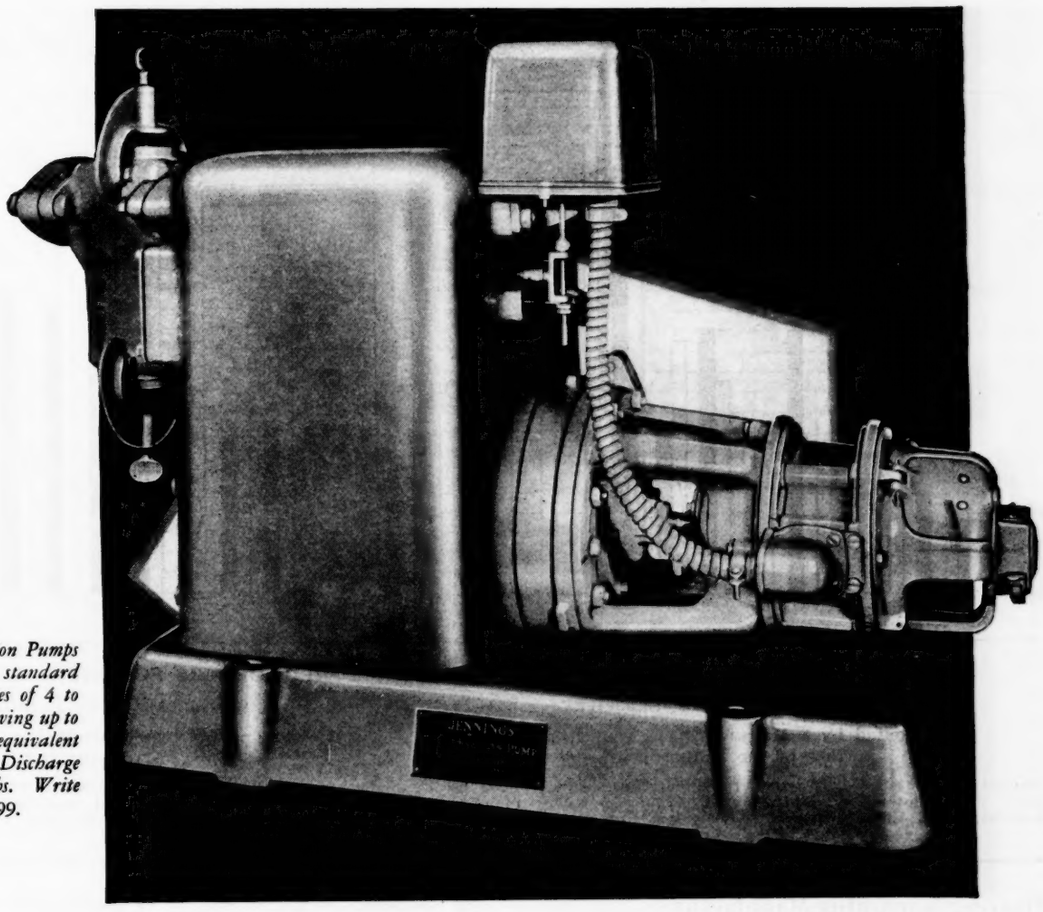
SHIPMENTS OF CAST-IRON ROUND BOILERS

(In Thousands of Pounds)

As Reported by 25 Manufacturers Representing 90% of the Industry

September, 1930, 12,162; September, 1929, 18,263; decrease over last year, 33.4%; total for nine months, 1930, 64,012; total for nine months, 1929, 99,853; decrease over last year, 36%.

(*Continued on page* 126)



Jennings Condensation Pumps are furnished in standard sizes, with capacities of 4 to 200 g. p. m., for serving up to 150,000 sq. ft. of equivalent direct radiation. Discharge pressures up to 60 lbs. Write for Bulletin 99.

Operating basement radiators . . . *efficiently*

BY clearing radiators located below boiler water line of condensation, the Jennings Condensation Pump makes possible a full unobstructed flow of steam. By returning the hot condensate to the boiler it contributes to economical heating.

Compact and sturdily constructed the Jennings Condensation Pump combines receiving tank, pump and driving motor in a single assembly. Automatically controlled, it requires no attention other than occasional packing and lubrication.

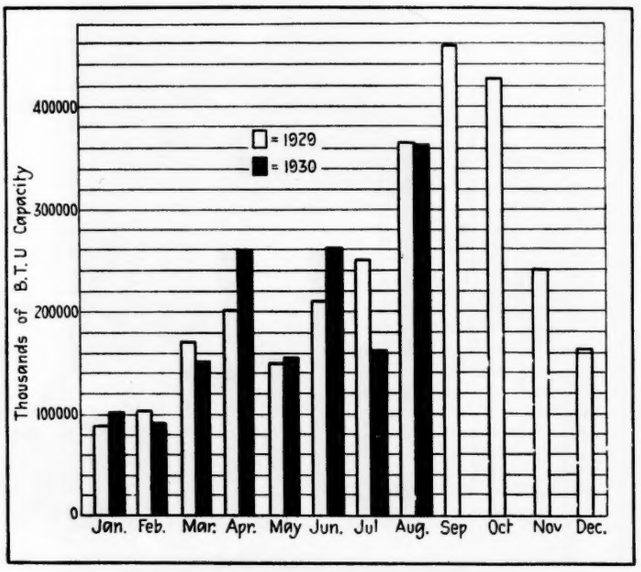
The centrifugal impeller is mounted on a short extension of the motor shaft. Pump casing is cast as an integral part of the tank. A rigid bracket supports the motor and insures perfect alignment of shaft and working parts independent of the base. There is only one stuffing box. No flexible coupling is required.

Nash Engineering Co., 81 Wilson Road, South Norwalk, Conn.

Jennings Pumps

Statistical Service

(*Continued from page* 124)

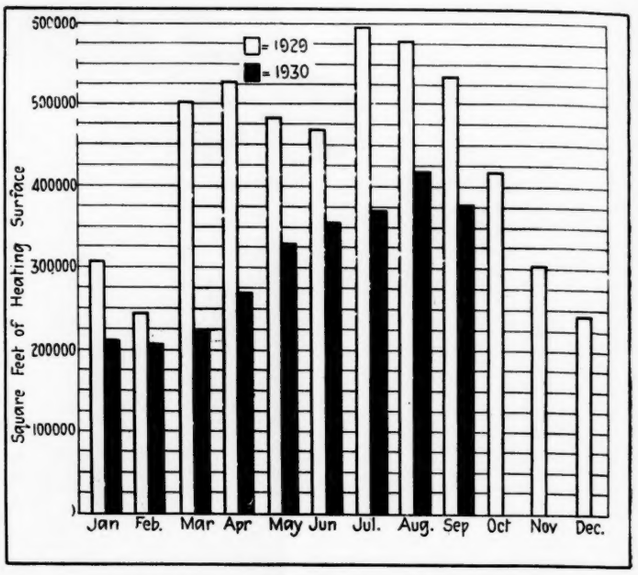


SHIPMENTS OF GAS-FIRED BOILERS

(In Thousands of B.T.U. Capacity)

As Reported by 8 Manufacturers Representing 75% of the Industry

August, 1930, 364,861; August, 1929, 365,280; decrease over last year, 0.1%; total for eight months, 1930, 1,543,109; for eight months, 1929, 1,536,228; increase over last year, 4.48%.



NEW ORDERS FOR STEEL HEATING BOILERS

(In Square Feet of Heating Surfaces)

As Reported by Firms Making Up the Greater Part of the Industry

September, 1930, 376,917; September, 1929, 536,888; decrease over last year, 29.8%; total for nine months, 1930, 2,775,864; total for nine months, 1929, 4,259,188; decrease over last year, 34.9%.

Heating Apparatus Manufacturers Report Increase of 3.9% for 1929 Over 1927

The Bureau of Census has announced that, according to data collected in the *Census of Manufacturers*, 1930, the total value of products shipped or delivered in 1929 by establishments engaged primarily in the manufacture of heating apparatus, steam fittings, and stoves, amounted to $502,418,765, an increase of 3.9% over the figures for 1927, the year of the last preceding census of manufacturers.

Detailed figures include:

PRODUCT	1929	1927
Steam and hot-water heating apparatus, total	$83,328,757	$110,154,748
Steam and hot-water heating boilers, etc	41,953,181	52,884,809
Cast iron	32,956,297	46,071,714
Steel	7,541,576	6,813,095
Parts	1,455,308	†
Radiators	41,375,576	57,269,939
Cast iron	38,198,711	*
Copper	2,757,207	*
Other	419,658	*
Warm-air furnaces and parts	39,600,576	.....
Warm-air furnaces	29,935,498	43,189,321
Parts, including registers	9,665,078	*
Unit heaters	7,926,724	*
Domestic fuel oil burners, total	19,151,771	11,501,819
Mechanical (forced) draft for furnaces and ranges	16,237,443	10,716,739
Atmospheric (natural) draft	2,914,328	785,080
Fittings and valves, total	82,802,747	104,118,110
Brass	21,369,696	*
Cast iron (except bell and spigot)	22,632,342	*
Malleable iron	23,628,659	*
Steel (cast or forged)	10,782,058	*
Other, and not separately reported	4,389,992	.....
Specialties (gauges, steam traps, reducing valves, relief valves, etc.)	51,357,350	*

(†) Included in "Parts and fittings, other than steam fittings."
(*) Not reported separately.

Elementary Information for the Coal Fireman

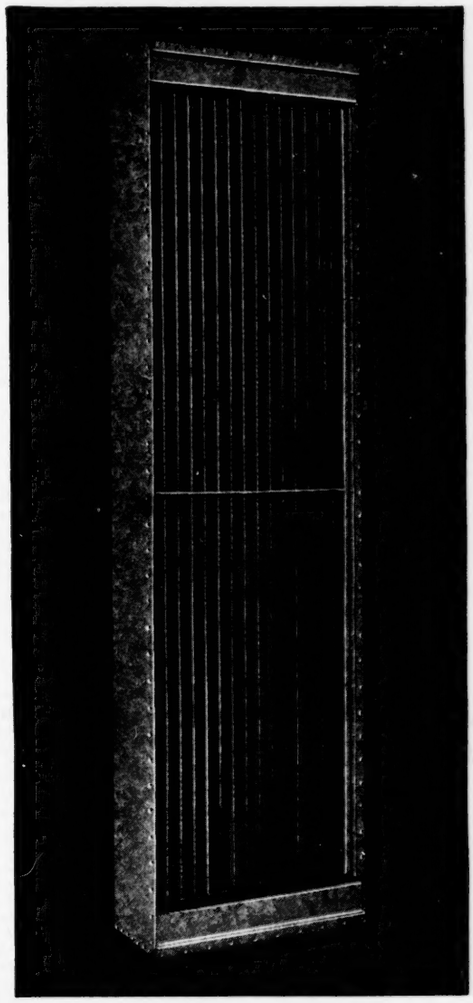
A selection of elementary information for firemen is contained in a booklet entitled "Questions and Answers for the Coal Fireman," by J. F. Barkley, just published by the United States Bureau of Mines, Department of Commerce. The booklet is written in easily understandable language, and is intended to give the fireman a clear, concise idea of just what happens when coal is burned under a boiler furnace and of the best methods of firing to avoid waste and smoke. It is in pocket size and has a flexible cloth cover.

Standard Regulations on Pulverized Fuel Systems

A new edition of "Standard Regulations on Pulverized Fuel Systems," incorporating the text prepared by the N.F.P.A. Committee on Dust Explosion Hazards, has been published by the National Fire Protection Association. The text was adopted by the association at its last annual meeting and has been approved as an American Standard by the American Standards Association. The previous revision was published in 1927. Copies of the new regulations may be obtained from the National Board of Fire Underwriters, 85 John St., New York.

ENCASED ARCOBLAST HEATERS

for the largest manufacturers of COMPLETE RADIO RECEIVING SETS



In the Spray-Booth Building of Grigsby-Grunow Company in Chicago, manufacturers of Majestic Radios, 6100 lineal feet of Arcoblast are supplying fresh air.

Here is another case where the high efficiency and light weight of Arcoblast make it the ideal radiation for perfect ventilation.

Heating Engineer—Martin C. Schwab, Chicago Heating Contractor—John R. Kehm Company, Chicago Fan Equipment — American Blower Company.

AMERICAN RADIATOR COMPANY

DIVISION OF

AMERICAN RADIATOR & STANDARD SANITARY CORPORATION

816 So. Michigan Ave., Chicago 40 West 40th St., New York City

Classified Advertising

Advertisements under this heading, $2 per inch, payable in advance. A 1-in. advertisement contains about 35 words in this size type. Larger type and spacing at $2.00 per inch. To secure insertion copy must be received not later than the 20th of the month preceding date of issue.
HEATING AND VENTILATING — 521 Fifth Ave., New York, N. Y.

SALES OPPORTUNITY

for a man or a sales organization

Exclusive sales franchise with protected territory on complete line of Heating and Cooking Apparatus manufactured by one of the oldest and best known companies in the country. Lines consist of Cast Iron and Steel Pipe and Pipeless Warm Air Heaters, Cast Iron and Steel Steam and Hot Water Boilers and Heating Specialties. Large new selling field which offers unusual profit possibilities. Man or Organization must be qualified to act as distributor. Home office will support authorized distributor with direct mail and newspaper advertising without cost to distributor. We do not pay drawing accounts, as our experience shows that the type of man or organization we desire does not need this help. Commissions are unusually liberal and are payable when sale is made. If you can qualify, write in confidence, outlining experience and qualifications and definite appointment will be made.

BOX 130,
HEATING AND VENTILATING

—WANTED—

Manufacturer's Representatives

We have several openings for high class representatives to contact distributors and dealers, having exclusive selling franchises on the Wayne Oil Burner and Wayne Electric Refrigerators. Applicant must have successful record in sales together with sound engineering education. An unusual opportunity for men handling not in excess of two or three non-competitive lines. State full details of experience, territory desired and companies represented at the present time.

WAYNE
HOME EQUIPMENT CO.
FORT WAYNE, IND.

The New York Blower Company requires successful and experienced fan and unit heater salesmen. For further information address The Sales Manager, 3155 Shields Avenue, Chicago, Ill.

MEN WANTED

To fill larger positions or make larger opportunities in a Billion Dollar Industry, like Heating, Ventilating, Refrigeration, and Sanitary Engineering.

We have just revised and enlarged our unexcelled Home Study Courses. They are now brand new for 1930-31 men to use in carving out more steady work, larger positions, more income, etc. Men with ambition and anxious to get ahead will find these Courses just what they need to lead them into higher executive positions.

This is our 21st year Training Monarchs of the Trade. Let us include YOU in our Student body this Fall. Get your copy of our new Directory—it's free to men who want to get ahead. Entire satisfaction is guaranteed by our Instruction methods. Write Now, by checking your Course.

- ☐ Heating, Ventilating and Refrigeration Engineering.
- ☐ Special Warm Air and Forced Air Heating.
- ☐ Steam and Hot Water Heating.
- ☐ Air Conditioning for Fan H. and Eng.
- ☐ Plumbing and Sanitary Engineering.
- ☐ Contracting and Estimating.

The St. Louis Technical Institute
4543 Clayton Ave. ST. LOUIS, MO.

ENGINEERS! JOBBERS!

1100 Steam Traps at *Less than Cost!*

Distributor, discontinuing all steam specialty lines in order to concentrate on sale and manufacture of own products, has 1,100 steam traps of well-known make in stock.

These traps can be bought for less than cost in lots of 100 and over.

Write Box 135
care of Heating and Ventilating

STEEL HEATING BOILERS

Complete Line

We have some territory open for sales organization or representative with experience calling on Engineers, Architects and Heating Trade.

MONITOR BOILER COMPANY
1505 Race Street, Philadelphia, Pa.
affiliated with
United Dry Docks, Inc., New York City
See Our Advertisement in This Issue on Page 10

BUSINESS OPPORTUNITY

A well-known manufacturer of a complete line of specialties for

Vacuum and Vapor Heating Systems

has openings for

EXCLUSIVE SALES REPRESENTATIVES

in various parts of the country.

Correspondence is invited from established Manufacturers' Agents handling kindred lines, and also from

Successful Sales Engineers

who would like to establish their own business.

New developments now being perfected will make this one of the most desirable accounts in the industry.

ALL REPLIES CONFIDENTIAL.
ADDRESS BOX 131,
care of Heating & Ventilating

SALES REPRESENTATIVE WANTED—An excellent opportunity with unlimited financial possibilities, either as direct salesmen or as sales representatives, is offered, covering a complete line of vacuum, vapor and steam heating specialties, a complete system of temperature regulation, fans, air washers, and unit heaters. Only those with technical education and thoroughly experienced in one or more of the lines will be considered. Give complete history of selling experience with reference to territory covered, name of company now associated with, etc. Applications confidential.

THE BISHOP & BABCOCK SALES CO.
Cleveland, Ohio

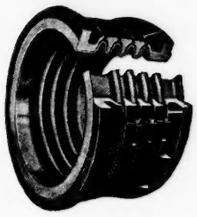
REPRESENTATIVE CONCERN WANTED to handle a new and distinctive line of Ventilating Equipment which is without competition in its field. Attractive proposition to responsible parties. Address Box 132, care of Heating and Ventilating.

SALES EXECUTIVE—An exceptional opportunity for a thoroughly qualified Sales Manager and Stimulator. Must be thoroughly familiar with all phases of the Heating and Ventilating industry, and possess a National favorable acquaintance with Jobbers, Dealers, Architects and Engineers. Preference will be shown to one in a position to bring with him goodwill in the form of distributing connections and customers. In reply, submit complete details which will be treated in strict confidence. Address Box 134, care of Heating and Ventilating.

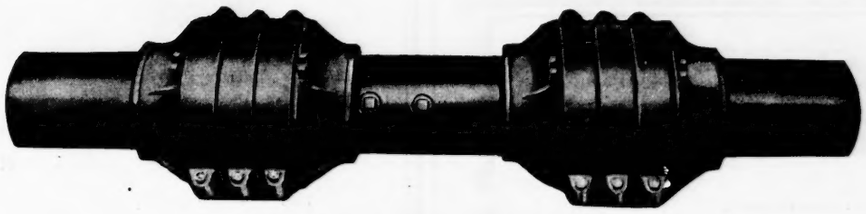
POSITION WANTED with contractor for heating, ventilating and power piping. Have had many years' experience estimating, engineering and superintending installations. Address Box 136, care of Heating and Ventilating.

SALES ENGINEER EXECUTIVE, POSITION WANTED—On salary and bonus basis with at least average-sized manufacturer; preferable in fan blast or gas heating lines. Can show training, experience, and present connection to qualify. Age 33, married, member of technical society. State tentative proposition. Address Box 133, care of Heating and Ventilating.

THE SECRET OF BADGER JOINT SUCCESS



...knowledge of copper, and skill in fabricating the most vital part of the joint---the seamless tube of special copper.



Welding-end and Flanged-end Joints. Small cut at right shows Monel Metal sleeve for use with superheated steam.

THE BADGER Self-Equalizing Expansion Joint has been in the market for years. Thousands of units are installed. The service given is universally satisfactory.

Back of this record is a long period of extensive study and experimentation, and long ago two important facts were definitely established:

1. that only a certain kind of copper is suitable for making corrugated seamless tubes;
2. that exceptional skill is needed in fabricating the tubes.

The record of the many thousands of Badger Joints in service presupposes on the part of Badger a thorough knowledge of copper, and skill in fabricating it. This record is your assurance of an excellent joint when you buy Badger Joints.

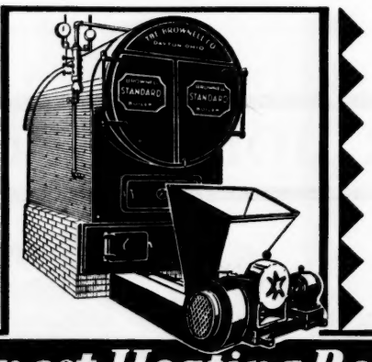
Atlanta, Georgia, Red Rock Bldg.
Charlotte, N. C., 1408 Independence Building
Chicago, Ill., 2831 South Parkway
Cincinnati, Ohio, Union Trust Bldg.
Cleveland, Ohio, Guardian Bldg.
Detroit, Mich., 402 Ford Bldg.
Houston, Tex., 1308 Sec. Nat. Bk. Bldg.
Indianapolis, Ind., 823 Occidental Bldg.
Kansas City, Mo., 1336 Oak Street
Los Angeles, Cal., 517 Hollingsworth Building

E. B. BADGER & SONS COMPANY

67 Pitts Street, Boston, Mass.

Minneapolis, Minn., 732 Build. Exch.
Montreal, Que., Can. Cement Bldg.
New Orleans, La., 419 Maritime Bldg.
New York City, 271 Madison Ave.
Philadelphia, Pa., 1500 Walnut St. Room 901
Pittsburgh, Pa., Union Trust Bldg.
Salt Lake City, Utah, Kearns Bldg.
San Francisco, Cal., Sharon Bldg.
Seattle, Wash., 415 Lenora Street
St. Louis, Mo., 3605 Laclede Ave.

BADGER EXPANSION JOINTS



The Finest Heating Boiler that Unrestricted Effort Can Achieve

A welded steel design that presents features obtainable only in the Brownell. An unparalleled combination of advanced design, carefully selected materials and unquestioned workmanship.

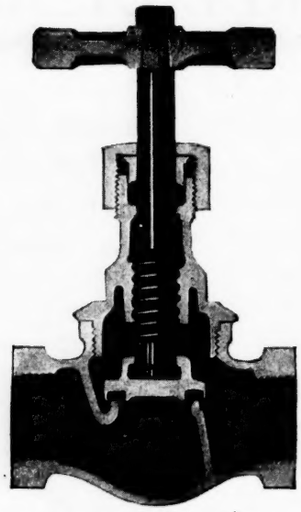
Recommended for heating requirements in homes, apartments, hospitals, country estates—wherever the demand for uniform, ample and economical heat must be met in the most approved manner.

Larger fire box
Greater radiant heating surface
Faster steaming
Special provision for auxiliary hot water in hot weather and odorless incineration.

THE BROWNELL COMPANY, Dayton, Ohio
Established in 1855 Representatives in Principal Cities

BROWNELL
THE BALANCED HEATING UNIT

Fairbanks Valves
A Type for Every Service



STEAM
WATER
GAS
OIL
AIR
and
ACID
LINES

In Bronze and Iron

Fig. 01—Sectional View

Designed and Manufactured by

The Fairbanks Company
BOSTON NEW YORK PITTSBURGH
Factory: Binghamton, N. Y.
Distribution in All Principal Cities
WRITE FOR COMPLETE CATALOG

G&O
FINNED TUBING
Quality Service

WE are splendidly equipped to supply all types of finned tubing for copper radiation.

CORRESPONDENCE INVITED

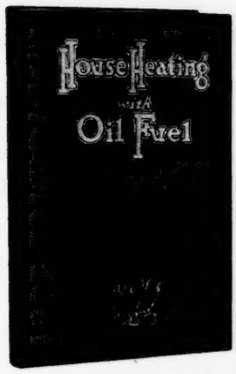
THE G & O MANUFACTURING COMPANY
New Haven, Conn.
Established 1915
Manufacturers of the famous "G & O" Radiators for automotive vehicles

The KAINER PRESSURE GOVERNOR
For Hot Water Heating Systems

Reduces the cost of a hot water layout.
Eliminates expansion tank and fittings (with its danger of freezing and overflowing).
Simplifies installation—makes a better job.
Saves your time and your customers' money.
Increases your profits and builds good will.

Write us for full information

KAINER & COMPANY CHICAGO
761-771 MATHER STREET
Manufacturers



Every heating engineer and contractor should be fully posted on the developments in the use of oil fuel in house heating; whether he is selling equipment for it, or meeting it as competition. There is no better source of information than this unbiased treatment of the entire field by P. E. Fansler, E.E. 150 especially prepared photographs, diagrams, and charts are used to illustrate it. A glance at the Table of Contents given below will show how comprehensive it is.

Contents by Chapters

1. The Era of Automatic Control. 2. The Use of Liquid Fuels For House Heating. 3. Oil Fuels—Definitions, Characteristics and Specifications. 4. Oil Fuels—Source, Preparation and Distribution. 5. Combustion—Theory. 6. Combustion—Practical Considerations. 7. Boilers For Use With Oil Burners. 8. Boilers Particularly Adapted to Oil Burning. 9. Warm Air Furnaces For Use With Oil Burners. 10. Oil Burners—Types—Characteristics. 11. Oil Burners—Atmospheric. 12. Oil Burners—Mechanical Draft. 13. Oil Burners—Mechanical Draft (continued). 14. The Control of Oil Burners. 15. Oil Burner Accessories. 16. Tanks and Storage. 17. Efficiencies. 18. The Iso-Degree Day Chart and the Iso-Oil Consumption Chart. 19. The Value of House Insulation. 20. Selling Oil Burners. 21. How Many Gallons of Oil Equal a Ton of Coal. 22. Checking the Radiation. 23. Checking the Heating Plant Installation. 24. Installing the Oil Burner. 25. The Underwriters' Regulations. 26. Heating Service—Servicing Oil Burners. 27. Buying An Oil Burner. 28. What the Underwriters' Listing Means. 29. Domestic Oil Burners Listed by the Underwriters' Laboratories. 30. Oil Burner Ordinances. 31. Oil Burner Fires. 32. Bibliography.

362 Pages, 7x10 Ins. 150 Figs. Cloth. Price, $4.00. Postpaid.

Give Helpful Books for Christmas!

A. S. H. & V. E. Guide, 1931 Edition.

Everyone interested in the heating field should have this standard reference book. The 1931 edition gives the very latest developments and has many new chapters. All types of installation are fully covered and special attention is given to Ventilation, Air Conditioning, District Heating, Codes and Standards. The catalogue section shows what has been accomplished by the manufacturers during the past year. Over 1,000 Pages, 6 x 9 Inches, Flexible Fabrikoid. Price, $5.00.

Heating and Ventilation. *By Harding and Willard*

The revised and enlarged edition of this standard reference book will prove one of the most valuable guides to modern practice that the contractor or engineer can obtain. The first edition proved so helpful that over 12,000 copies were sold. 963 Pages, 7 x 9 Inches. 631 Figures. Flexible Fabrikoid. Price, $10.00.

Contents: I—Physical Units and the Measurement of Heat, II—Water, Steam and Air, III—Fuels and Combustion, IV—Steam Heating Boilers and Hot-Water Heaters, V—Draft and Chimneys for Heating Boilers, VI—Heat Transmission of Buildings and Insulating Materials, VII—Estimating Seasonal Heating Requirements for Various Types of Buildings, VIII—Heat Transmission and Dimensions of Direct Radiators, IX—Direct Steam Heating, X—Exhaust Steam Heating, XI—Direct Hot-Water Heating, XII—Heating Water in Tanks and Pools, XIII—Electrical Heating, XIV—Ventilation, Air Analysis and Ventilation Laws, XV—Gravity—Indirect Heating by Steam and Hot Water, XVI—Warm-Air Furnace Heating, XVII—Hot-Blast Heating, XVIII—Air Conditioning, Air Washing, Humidifying, Cooling and Drying, XIX—Automatic-Temperature and Humidity Control, XX—Central Station or District Heating, XXI—Pipe, Fittings, Valves, and Accessories, XXII—Preparations of Plans, Specifications and Estimates.

Heating Data Sheets.

These tables were especially compiled to cover subjects of vital interest to the trade and the greater part of this information will not be found in any other handbook on this subject. It is loose leaf in form so that it may be kept up to date by the insertion of additional data sheets from HEATING AND VENTILATING.

Among the important subjects covered are: Heating Loss Tables, brick, stone, concrete, combinations, tile, frame construction, etc. Jones Heat Loss Tables, 26 authorities, covering every type of construction. Temperature Ranges in U. S., Computing Heat Losses, Ventilation, Air Changes, in all types of Buildings. Measurements of Air Flow, Ducts and Flues, Sizing Methods, Details and Weights, Computing Radiation, Steam and Water, Oil Heating, Boilers, Chimneys, Pipe Covering, Flow of Steam and Pipes, One-Pipe Steam Systems, Vacuum Heating Systems, Gravity Water Heating Systems, Fans, Belts, Drives, Exhauster Systems, Chemical Laboratories, Steam Laundries. 205 Pages of Tables and Data. 6 x 9½ Inches, Illustrated, Canvas Loose-leaf Binder. Price, $7.50.

Practical Heating Systems, Trouble Jobs and Ventilation. *By E. W. Riesbeck.*

The principal consideration in this book has been directed toward the proper installation of piping, correct layouts, and the discussion of the numerous details which are neglected in the more technical books on heating written primarily for the engineer. Particular attention has been paid to the operation of the heating plant and the curing of trouble jobs. 277 Pages. 5 x 7½ Inches. 82 Figures. Flexible Fabrikoid. Price, $4.00.

Gravity Steam and Water Heating. *By Ara Marcus Daniels.*

This practical series of twenty-nine (29) loose-leaf booklets covers the fundamentals of heating and ventilating, gives technical instructions for the design and layout of all types of steam, water, vapor and vacuum systems, and includes descriptions of conventional pipe connections, fittings and appliances used with such installations. Special chapters are devoted to a discussion of the capacity, dimensions and particular features of various types of radiators. Fundamentals of steam properties, the combustion of coal, and a description of various types of boilers are treated, together with special chapters on chimneys and draft. 561 pages in loose-leaf form in two special canvas ring binders. Price, $12.50.

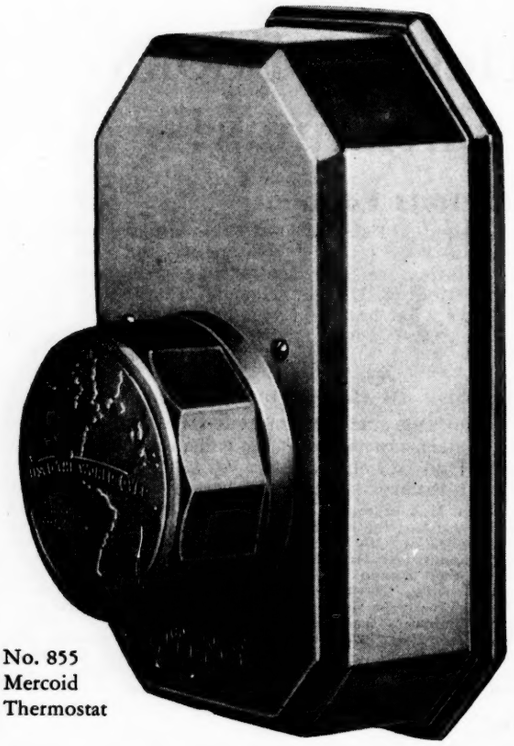
Heating and Ventilation. *By Rietschel and Brabbee.*

This is the famous Heizungs und Lüftungstechnik, translated and adapted to American practice. It deserves a place in every working library on Heating and Ventilation.

Contents—Part 1. Introduction, Methods of Heating, Central Heating. Part 2. Necessity of Ventilation, Required Air Changes, Means of Insuring Air Changes, Cooling of Rooms. Part 3. Determination of Required Air Changes, Formulas for the Design of Details of Ventilating Systems, Cooling and Drying Air, Approximation. 352 Pages 6 x 9 Inches, 186 Figures, 7 Folding Charts. Cloth. Price, $4.50.

Money Back, If Returned in Good Condition Within 5 Days. Sent Prepaid on Receipt of Price by

Heating and Ventilating Book Service, 521 Fifth Avenue, New York



No. 855
Mercoid
Thermostat

The **Ideal Control** for Unit Heaters

All over the country, in buildings large and small, Mercoid is controlling Unit Heaters—and maintaining a constant even temperature.

Mercoid controls the temperature by starting and stopping the fan, automatically—and on units up to 1 H. P. no relay or starting switch is needed. It is regularly furnished in two ranges one 56° to 80° and the other 58° to 60°. The latter is designed for buildings only slightly warmed—such as garages, warehouses.

Engineers have found that this accurate regulation brings about real savings in both steam and electricity and at the same time increases the efficiency of workers.

No. 855 Mercoid is low in price, accurate and dependable. At small extra cost, it may be equipped with a locking device that prevents tampering or changing the adjustment.

A postcard will bring you complete information without any obligation.

MERCOID is manufactured and sold by

AMERICAN RADIATOR COMPANY

Division of

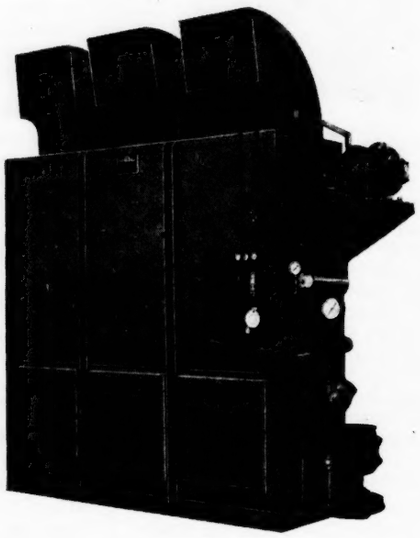
AMERICAN RADIATOR & STANDARD SANITARY CORPORATION

DEPT. MA-11 . . 40 West 40th Street . . NEW YORK

AIR CONDITIONING

. . For Large or Small Areas

is most successful by the unit system when Niagara Air Conditioners, individually or in batteries, are installed.



Each Niagara machine is a complete air conditioner. It cleans the air more thoroughly than conventional type washer . . controls temperature and moisture content within the closest limits by a new and superior control . . dehumidifies and cools with a maximum of efficiency because saturation is secured.

Niagara Air Conditioners are available in capacities from 800 to 11,000 C.F.M.

Detailed information will gladly be furnished upon request.

NIAGARA BLOWER COMPANY

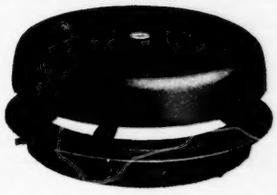
AIR CONDITIONERS
ALUMINUM HEATER COILS
FAN HEATERS
FAN COOLERS
COOLING SURFACE
SYSTEMS FOR COOLING, HUMIDIFYING, DRYING,
DUST RECOVERY
SOLVENT RECOVERY,
PNEUMATIC CONVEYING

General Sales Office: 95 Liberty St., New York City.

Buffalo, Philadelphia, Pittsburgh, Boston, Cleveland, Detroit, Montgomery, Ala.

NIAGARA BLOWER COMPANY BUFFALO, N.Y.

NIAGARA



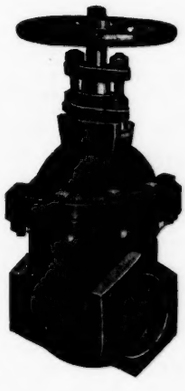
Greetings

The manufacturers of TURTLEBACK *and* ENFLO AIR DIFFUSERS *are proud to announce that in spite of the general depression throughout the country, there has been a decided increase in the sale of their products.* ¶ *We are indebted to the architects, engineers and contractors who have recognized the merits of the* TURTLEBACK *and* ENFLO DIFFUSER *and made this condition possible, and wish to take this opportunity to wish them all a*

Merry Christmas
And A Prosperous Year for 1931

VENTILATING PRODUCTS CO.
2800 Cottage Grove Avenue
CHICAGO, ILLINOIS

IRON BODY GATE VALVES



SCREWED, FLANGED
AND
HUB END STYLES

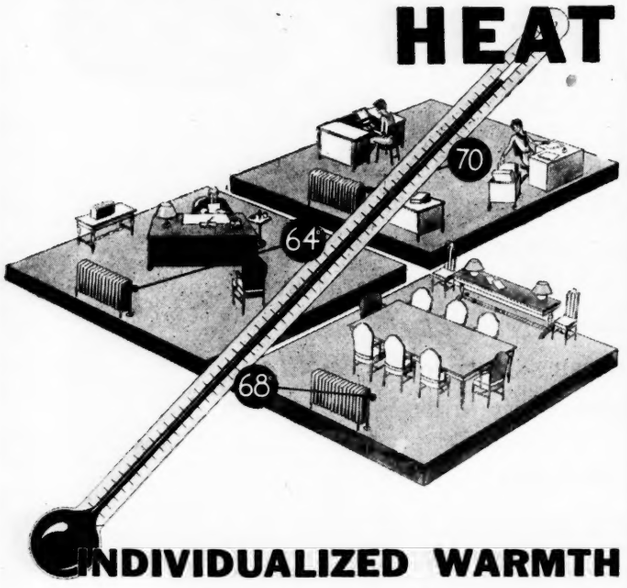
NON-RISING STEM
AND
O. S. and Y. PATTERNS

ALSO MANUFACTURERS OF
Cast and Malleable Iron Fittings
Brass Valves and Fittings

Illinois Malleable Iron Company

1801 Diversey Parkway :-: :-: Chicago, Ill.

"Made to Measure" HEAT



INDIVIDUALIZED WARMTH TO FIT EACH ROOM

Sylphon Automatic Radiator Valves assure a better general heating for any building — because they prevent fluctuating room temperatures, one common cause of fuel waste. The Sylphon Automatic Radiator Valve is made to do just one job — and does it. Sensitive to the slightest temperature changes of the surrounding air—it steadily holds the warmth of any one room at exactly the degree most satisfactory to the occupants. Once its marked thermostatic head is set at "Hot," "Medium," or "Cold" there the temperature stays. Practically the entire thermometer range of comfort may be scaled for the individual warmth selection and once set all further radiator attention is avoided. Sylphon Automatic Radiator Valves positively eliminate uneven, injurious and wasteful heat for Factory, Office Building, Apartment or Home.

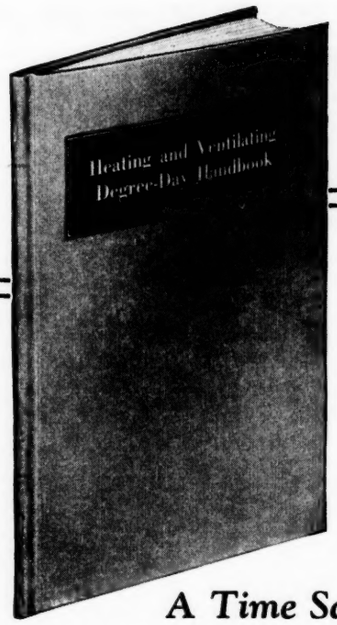
A COMPLETE RADIATOR CONTROLLING DEVICE

The Sylphon Automatic Radiator Valve is a combination packless valve and temperature control unit. Its motor element is the dependable Sylphon Bellows. It has no electrical or mechanical accessories to get out of order. Easily installed and inexpensive—architects and engineers specify it with full confidence in its lasting efficiency.

It is fully described (both types — angle and globe) in our illustrated printed matter which will be gladly sent. Write today for Bulletin XH 250.

FULTON SYLPHON CO.
KNOXVILLE, TENN., U.S.A.

Representatives in all Principal Cities in U. S. A.—European Representatives, Crosby Valve & Eng. Co., Ltd., 41-2 Foley St., London, W. I., Eng.; Canadian Representatives, Darling Bros., Ltd., 140 Prince St., Montreal, Que., Canada.



A Time Saver!

This New Handbook

Gives Degree Days by Months for 1000 American Cities with State Maps and Coal, Gas and Oil Charts

SYNOPSIS OF CONTENTS

Definition of Degree-Day
What the unit is, what it means, how it originated, why the base 65° F. is used instead of some other figure, how much fuel, either oil, gas or coal, is required per square foot of radiation, and how to correct these figures for other conditions. This chapter also explains how the degree-day tables were calculated.

The Coal Chart, the Gas Chart and the Oil Chart
Three charts are included by means of which the fuel consumption can be determined per square foot of either steam or water radiation per degree-day for various efficiencies, heat content of fuel, design temperatures, etc. This new material was especially designed for this handbook.

Degree-Day Tables
The number of degree-days for each month in 1000 cities in the United States. While the total number of degree-days for these cities have been published, **NEVER BEFORE HAVE THE MONTHLY TOTALS BEEN AVAILABLE.** By means of these figures the engineer can estimate the fuel bill for every month for practically any locality in the country.

Degree-Day Maps, by States
Maps of all the States, either by small groups or by single States, showing the lines of equal degree-days. These enable the engineer to determine the degree-day load in territories adjacent to those for which the exact load is given in the tables.

Heating and Ventilating Degree-Day Map
The national map showing the lines of equal degree-days throughout the country.

The Industrial Degree-Day
Definition and tables of a new unit calculated on a lower temperature base than the standard degree-day for purposes of calculating fuel requirements of industrial plants which maintain an inside temperature lower than 70°.

The Industrial Degree-Day Map of U. S. A.
Gives all the figures at a glance.

56 Pages 5½x7½ Inches—3 Folding Charts
22 Maps, Cloth. Price $1.50 Sent Prepaid by

Heating and Ventilating Book Service
521 Fifth Avenue, New York

THE JONATHAN CLUB,
LOS ANGELES

Schultze & Weaver,
Architects.

Ralph E. Phillips,
Construction Engineer.

Thomas Haverty Co.,
Plumbing Contractors.

HOT WATER *by* WHITLOCK
in the CLUBS

The Jonathan Club of Los Angeles is one of the many prominent club buildings which are served by Whitlock Heaters.

The sound design — the careful attention to detail design and construction—and the nation-wide engineering service have led to the choice of Whitlock Heaters for this class of buildings, as for hotels, apartments, office buildings and others too numerous to mention.

For information or engineering service on Whitlock Products consult the nearest Whitlock District Office or representative, in New York, Boston, Philadelphia, Chicago, Detroit, Baltimore, Charlotte, Los Angeles, San Francisco and other principal cities.

Look under our name in your local telephone directory or drop a line to us at Hartford.

Whitlock Heaters, Preheaters and Heat Exchangers are manufactured in Canada by Darling Bros. Ltd., 120 Prince St., Montreal.

THE WHITLOCK COIL PIPE CO.

40 SOUTH STREET HARTFORD, CONN.

WHITLOCK SERVICE WATER HEATERS

NEW YORK BOSTON PHILADELPHIA
BALTIMORE DETROIT LOS ANGELES
CHICAGO SAN FRANCISCO

and other principal cities. Consult telephone directory.

There is a Difference in Boilers for Industrial Use

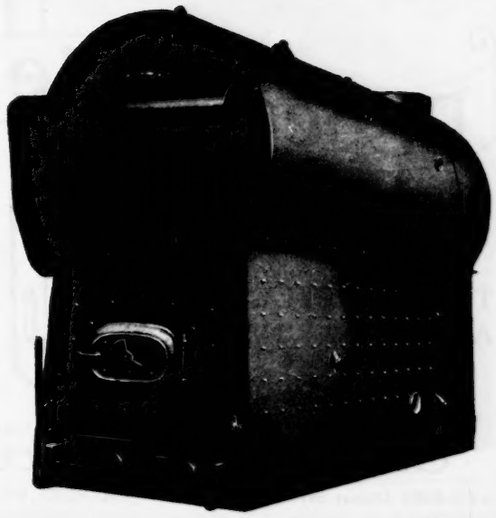
If you are a user of JOHNSTON Boilers you already know what this "difference" is. If you have not yet tried JOHNSTON steel heating boilers for industrial use, you have a genuine surprise waiting for you.

All good boilers for this purpose have the same general features. But the inherent qualities, the scientific design, the fuel-saving, heat-producing, trouble-free features that make JOHNSTON Boilers superior—are mostly inside, not so easy to see.

JOHNSTON Boilers possess this "difference" to such a degree that hundreds of Industries the country over are experiencing unexpected satisfaction with their JOHNSTON installations.

You too would find a favorable reaction in recommending JOHNSTON Steel Heating Boilers for industrial use.

Have you a copy of the newest JOHNSTON Catalog?



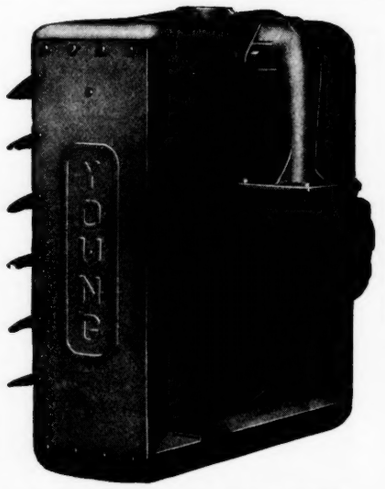
JOHNSTON BROTHERS, Inc.
BOX 360, FERRYSBURG, MICHIGAN

DUE to greater air delivery, higher velocity, and lower final air temperature Young Unit Heaters distribute the heated air more evenly over a larger floor area . . . Reducing to a minimum the temperature difference between the floor and the ceiling eliminates stratification of air and results in real heating economy.

Motors equipped with special sealed ball bearings which require no lubrication for a period of two to five years may be had at no additional cost. Four-speed motors are furnished at the same price as three-speed.

Young Unit Heaters

Built for Endurance and Maximum Performance



Patent No. 1753587. Other patents pending

YOUNG RADIATOR COMPANY

Heating Division

RACINE WISCONSIN

Representatives in Principal Cities

Correspondence Invited on Open Territories

Young Quality

Reg. U.S. Pat. Off. ©Y. R. Co.

HARTMANN

RADIATOR BRACKETS

THREE STYLES
AR NR NV

Write for Descriptive Circular and Price List

CHARLES HARTMANN CO.

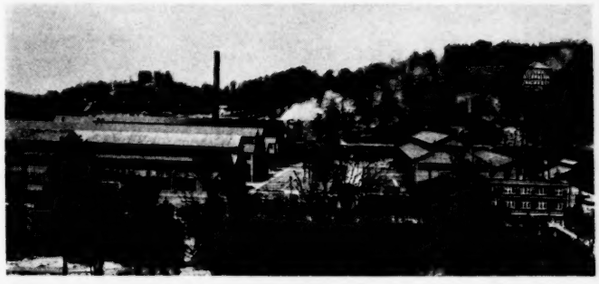
975-993 Dean Street BROOKLYN, N. Y.

HEATING
and
VENTILATING
Classified Advertising

is especially recommended for the attention of the manufacturers in the Industry who are desirous of meeting men of proven calibre and experience in their field.

ON
PAGE 128
IN THIS ISSUE

CLOW GASTEAM makes good in INDUSTRY



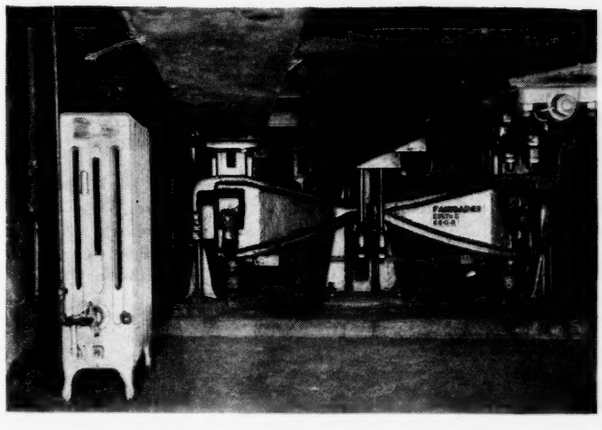
At the International Nickel Company — above — Huntington, W. Va.—Two-thirds of a million cubic feet of space in the main building, with 17 egress air vents, must have an air change every 6 minutes. Even though they were confronted with such an extremely difficult heating problem, Clow Gasteam Radiators maintain a room temperature of 70° with an outside temperature of 0°.

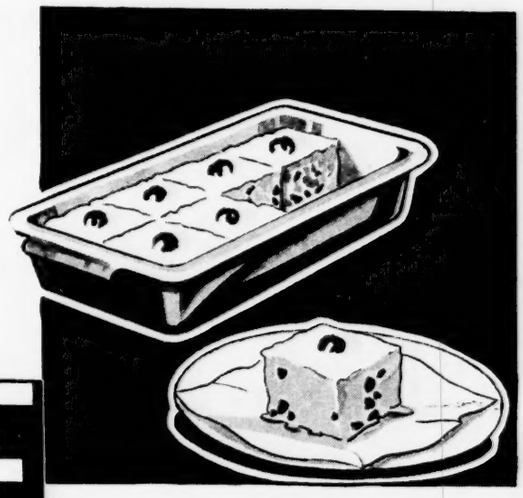
At Donner Witherow Steel Corporation, Pittsburgh, there was an almost inaccessible scale pit—shown below—which, for accurate scale operation, needed continuous, even heat. Two Clow Gasteam radiators were installed which, lit in the fall and turned off in the spring, guarantee correct scale readings.

These two unusual applications bear witness to the wide adaptability of Clow Gasteam—steam heat with gas—for a single room or an entire building.

JAMES B. CLOW & SONS
201-299 N. Talman Ave., Chicago, Ill.

CLOW GASTEAM
STEAM HEAT WITH GAS

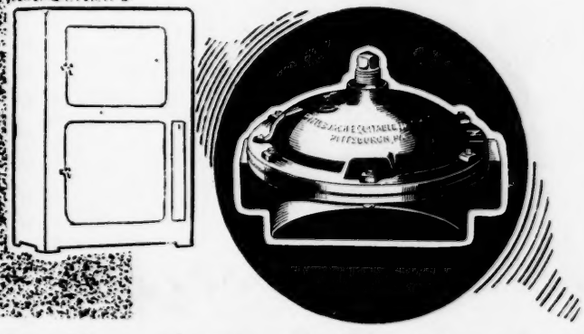




IF YOUR PRESSURE VARIES USE AN EMCO

Constant pressure at burners will keep your customers better satisfied.

Better pressure regulation means better refrigeration. EMCO Pilot Light Regulators are proving satisfactory on many refrigerator installations.



Pittsburgh Equitable Meter Co.

Main Office & Factories—Pittsburgh, Pa.

Branch Offices

Kansas City, Mo.
Tulsa, Okla.
Seattle, Wash.
New York, N. Y.
Chicago, Ill.
Columbia, S. C.
Houston, Texas
Dallas, Tex.
Los Angeles, Cal.
Salt Lake City, Utah

Burnham Boilers

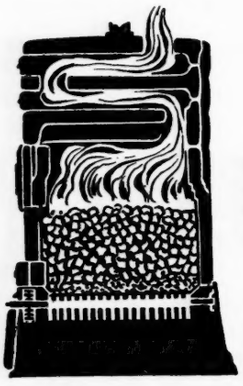
Every Greedy Boiler Makes Another Chance For a Burnham Sale

Old boilers and some not so old, have a habit of eating more and more and working less and less.

Burnhams are built to overcome just such fuel devouring conditions. Their extra length fire travel digests thoroughly all the fuel you feed them, therefore requiring less fuel to do the same work. They eat less and heat more.

Which is one reason why they make replacement business for alert Burnham dealers.

The Catalog shows why it is easy to install Burnhams in hard-to-reach places. Send for a copy.



Every Burnham, round or square, has this long fire travel that makes its coal bills short.

Burnham Boiler Corporation
IRVINGTON, NEW YORK
Representatives in all principal cities of the United States and Canada

The Sign B&J of Quality
Quality Heating Systems

A Merry Christmas and a Happy and Prosperous New Year!

Barnes & Jones, Inc.
128 Brookside Avenue, Jamaica Plain-Boston. 101 Park Avenue, New York City.

CHACE THERMOSTATIC METAL
"It Bends With the Heat"

An accurate, consistent and durable bi-metal for temperature responsive devices up to 1500° F. Mill sheets or finished form. Consult our Eng. Dept.

Manufactured by
W. M. CHACE VALVE COMPANY
1606 BEARD AVE. - DETROIT, MICH.

Will Appoint Distributors for Heating-Cooling Units

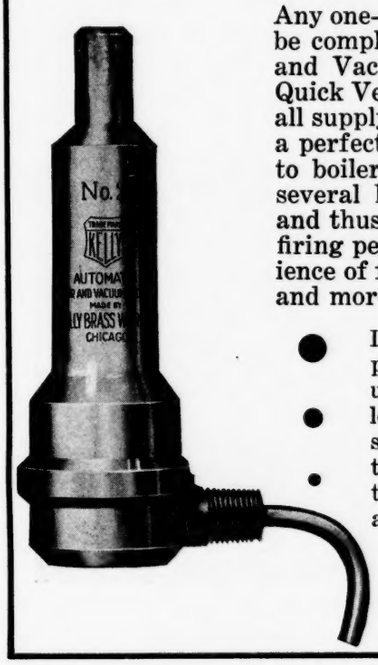
Established manufacturer of heating and cooling units wishes to get in touch with capable sales agents.

The line has particular merit and contains basic improvements which are exclusive. Units have been in satisfactory use several years by many large users. An aggressive advertising campaign is scheduled for coming years and full cooperation will be given those who are able to represent line properly.

Address HEATING AND VENTILATING, 75 E. Wacker Drive, Sixth Floor, Chicago, Ill.

• *For greater efficiency, economy and convenience, vacuumize with*

KELLY VALVES

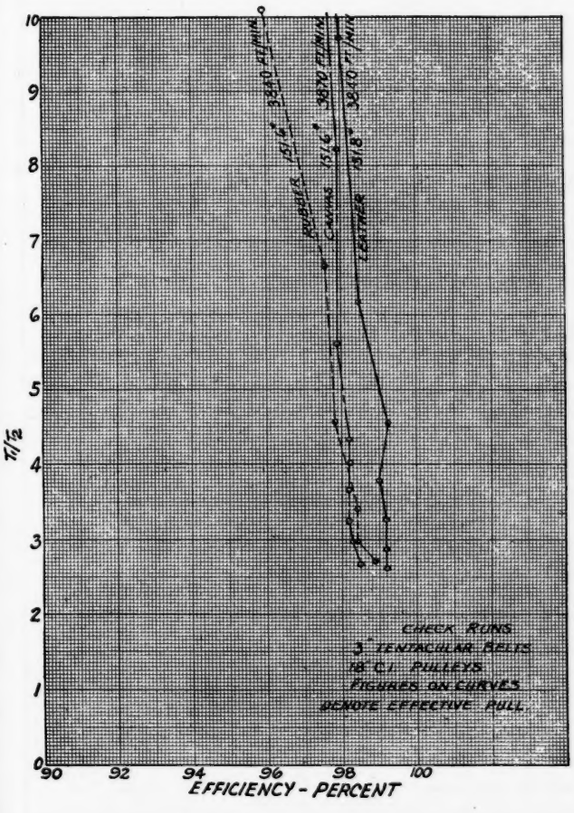


Any one-pipe steam heating system can quickly and easily be completely vacuumized by installing Kelly No. 2 Air and Vacuum Valves on each radiator and Kelly No. 6 Quick Vent Air and Vacuum Valves on each return. With all supply valves and connections air tight this will insure a perfect vacuum system that will give quicker response to boiler temperatures, maintain heat in the radiators several hours after the steam pressure has gone down and thus save an appreciable amount of fuel. In addition, firing periods are lessened, saving time and the inconvenience of frequent trips to the boiler—and greater comfort and more even temperatures are assured.

- Due to their simple sturdy construction, made possible by our basic patents, Kelly Valves stand up under long, hard service, yet are priced lower than any other five year guaranteed, steam and vacuum tested, quality valve. Write today for our new descriptive Price List illustrating our complete line of seven non-adjustable automatic steam, air or vacuum valves.

KELLY BRASS WORKS

226 W. Ontario St. CHICAGO, ILL.



WHAT IS YOUR EFFICIENCY IN POWER TRANSMISSION?

Or, in other words, how much money do you waste on your power bill through power transmission losses?

Some drives claim 99% efficiency, but they can't prove it, because it is not so.

The only drive that has ever shown an efficiency as high as 99% is TENTACULAR as per chart shown opposite, referring to a test made in 1929 at the Ohio State University.

All claims made for TENTACULAR are supported by numerous certified tests which is the reason why TENTACULAR is also the only drive having a world-wide reputation among engineers and technicians.

Do not fail to visit Booths 319 and 320, Power Show, and get acquainted with the facts

Alexander Brothers
INCORPORATED

Sole Makers of Tentacular Transmission Belt

19 South Street, Philadelphia

30 Church Street
New York, N. Y.

162 N. Clinton St.
Chicago, Ill.

HAVING GASKET PROBLEMS?

LET US SOLVE THEM FOR YOU!

We make metal gaskets of any size or shape, plain or corrugated, with or without asbestos, also plain solid washers of copper, aluminum, monel metal or any material desired. Our Gasket Guide shows a very complete line of gaskets.

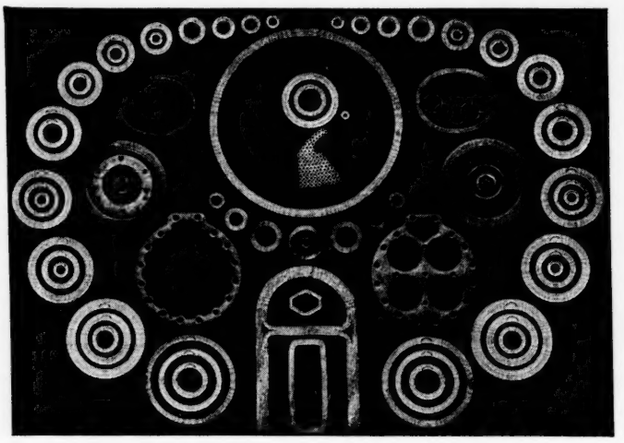
Copies sent upon request

GOETZE

Gasket & Packing Co., Inc.

28 Allen Avenue

NEW BRUNSWICK, N. J.



A Few Types of Goetze Gaskets

Turbo Heater

Turbo Heater uses Turbine drive. It is the only Unit Heater to operate on Low Pressure: it operates on both High and Low. The same steam is used for both drive and heat—a saving.

Turbo Heater eliminates any hazard from the use of electricity—it eliminates all cost of electric motor, wiring, labor, etc.—another saving.

But last and best, Turbo Heater eliminates forever the cost of current for electric drive. A third saving.

You will want to know more about these interesting savings. Ask any of us.

Automatic Turbo Heater Co.

343 So. Dearborn St., Chicago

DISTRICT REPRESENTATIVES

Philadelphia—T. T. Burchfield, 604 Arch St.
Boston—Starkweather & Broadhurst, Inc., 79 Milk St.
New York—Dudley-Curry, Inc., 377 Broadway.
Detroit—Factory Equipment Co., 2245 Blaine.
Louisville—Simms Thomas, 116 West Oak St.
Peoria, Ill.—G. E. Cumming, 111 Second St.
Indianapolis, Ind.—Phineas H. York, 946 East Washington St.
Pittsburgh—Frank Floyd, 3357 Bigelow Blvd.

The Thermotrol

An accurate room temperature regulator.
Makes room comfortable.
Saves from 20 to 40% of fuel.
Attractive in appearance.
Is as easily installed as a radiator valve.
Is reasonable in price.

Sterling Engineering Company

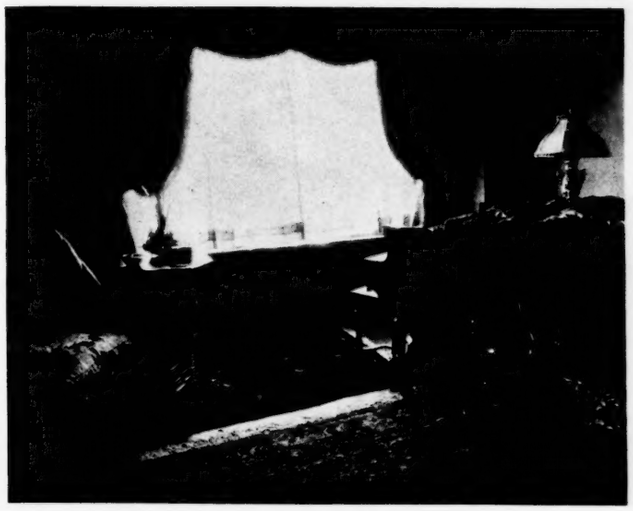
MILWAUKEE • • • WISCONSIN

PACIFIC

Welded steel construction for long life and few repairs . . . large combustion chamber to completely burn the fuel . . . extra direct heating surface, long fire travel to utilize every possible heat unit—these are some of the points which make Pacific Welded Steel Heating Boilers more satisfactory in service and more economical of fuel. In skyscraper or bungalow, they mean lower monthly heating costs. Architects, heating contractors, building and home owners will profit by writing for full information.

PACIFIC STEEL BOILER CORPORATION

General Offices: Detroit, Mich. *Factories:* Waukegan, Ill., Bristol, Pa.
Sales Offices in 58 Cities
Division of the United States Radiator Corp., Detroit, Michigan



"Could you picture this room with cast iron radiation?"

Not only is the Heat hidden but the efficiency is improved by

FINTUBE

FINTUBE Radiators are recommended to be built-in the wall. Skillfully hidden, behind enclosures which are designed to blend perfectly with the finest interiors, FINTUBE performs a service that is *instantly* accepted by building owners and tenants.

FINTUBE should be considered whenever performance counts

Heating contractors with an eye to public demand will do well in installing FINTUBE for sales and rentals are influenced by this modern heating unit.

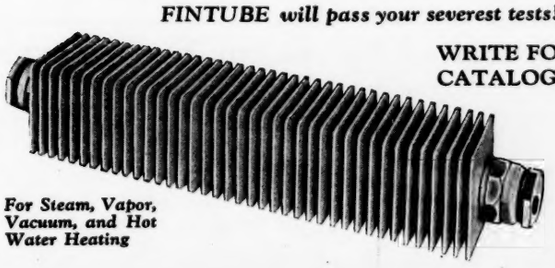
Whereby the advantages in appearance and installation are outstanding features of FINTUBE, the efficient performance and construction are even more important.

All of the heat is delivered to the room. FINTUBE saves from 10% to 20% in fuel consumption, since over 90% heat given off is convected heat.

Fins are integral part of tube, no welding, soldering, etc. Leak proof. Will last a lifetime.

FINTUBE will pass your severest tests!

WRITE FOR CATALOG



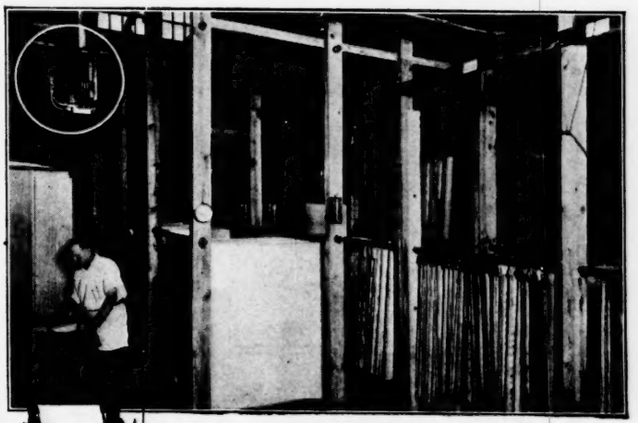
For Steam, Vapor, Vacuum, and Hot Water Heating

FINTUBE RADIATOR COMPANY, INC.

OFFICE AND FACTORY

44-02 to 20 11th Street Long Island City, N. Y.

Our Laboratories are available for testing any type of "fin" radiation

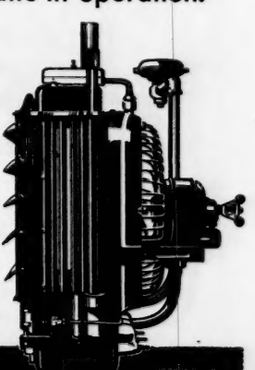


Protecting 5,000 Plates Against Costly Corrosion

At the Reynolds & Reynolds printing plant, Dayton, Ohio, the problem of protecting 5,000 expensive zinc plates was effectively solved with Humphrey Gas Unit Heaters. Heated air is circulated between the hanging plates reducing the relative humidity of the atmosphere to a point where corrosion and consequent loss are safely avoided.

While this is only one of the many special applications of Humphrey Gas Unit Heaters, hundreds of factories and varied industries depend upon these modern gas fired heaters as their sole heating equipment. They burn gas, the ideal fuel, in the most efficient manner and the circulation of air set up by a Humphrey Gas Unit Heater gives a greater heating efficiency than other methods. They are thermostatically controlled and automatic in operation.

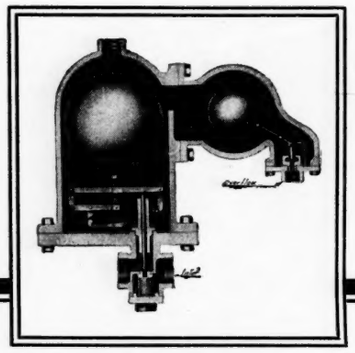
Why not get all the facts regarding these modern heaters? Interesting catalog sent on request.



A HUMPHREY PRODUCT
Manufactured by

GENERAL GAS LIGHT CO.
KALAMAZOO, MICHIGAN
New York » Pittsburgh
Cleveland » San Francisco

The Humphrey Gas UNIT HEATER



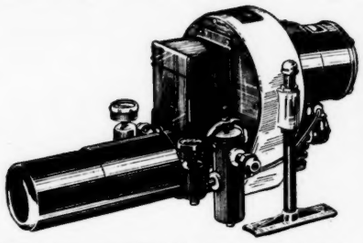
Kieley Duplex Feeders

There is a sure way to guarantee your customers safety and reliability. Duplex Water Feeders on every boiler you install is your best way to give both you and your work a lasting boost. Write us NOW for information you really should have regarding Kieley Specialties.

KIELEY & MUELLER, Inc.
Established 1879
34 West 13th St. NEW YORK CITY

KIELEY
REGISTERED TRADE MARK

The New Super CENTURY



Head and shoulders above competitors, the New Super Century combines the unfailing performance of the other Centuries with a number of new and exclusive features: Compact and balanced design, adjustable electrode assembly, special vacuum gauge, slow running pump, enlarged air capacity, self cleaning strainer in valve, and moving parts designed in one unit. Greater simplicity has resulted in even more economy, both in initial price and operation.

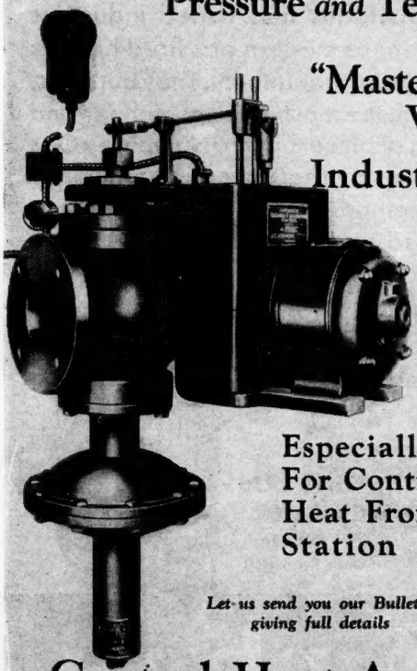
Don't fail to take advantage of our liberal discounts and the special Century Profit-Producing Dealer Franchise. More and more dealers and jobbers are changing to Century. Why not you? Write today!

CENTURY — YEARS OF SERVICE
TRADE MARK REGISTERED

As the Name Implies—Built for a Lifetime.

Manufactured by
CENTURY ENGINEERING CORP.
303 4th Ave. CEDAR RAPIDS, IOWA
Listed as Standard by the Underwriters' Laboratories

HORNUNG
Pressure *and* Temperature
2 *in* 1
"Master Control" Valve
(PATENTED)
Industrial Type



Motor Operated Directly by Thermostat

All Relays Eliminated ... ...

Especially Designed For Control of Steam Heat From a Central Station

Let us send you our Bulletin giving full details

Central Heat Appliances
J. C. HORNUNG, *Engineer*
343 South Dearborn Street Chicago, Illinois
(3475)

28 Superior Points have built success for Wolverine Unit Heaters.

Send for complete technical data.

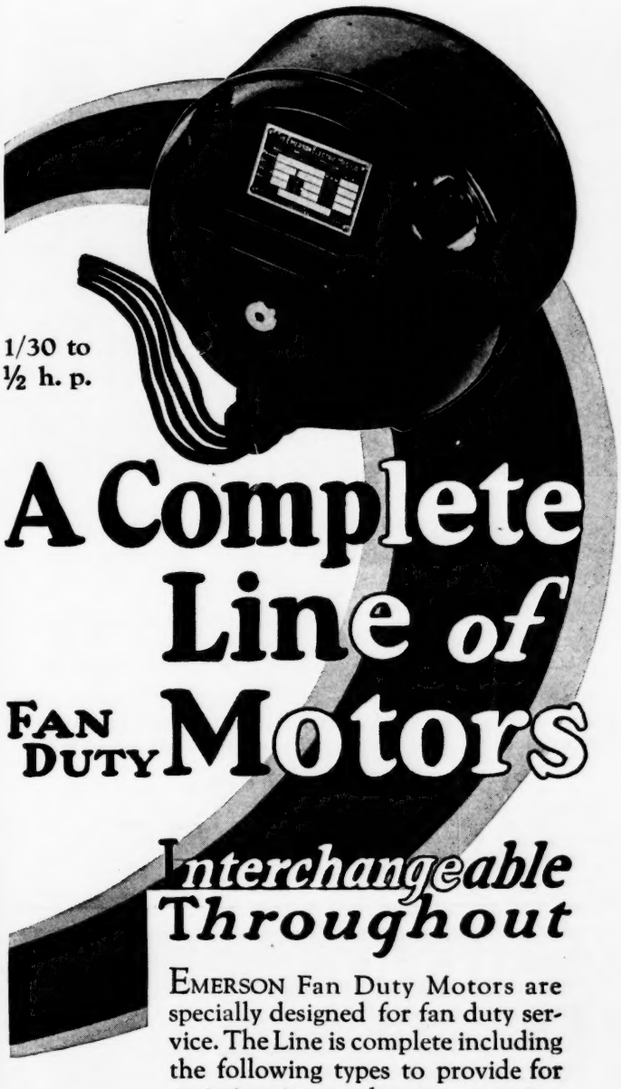
WOLVERINE TUBE CO.
SEAMLESS COPPER BRASS & ALUMINUM
1415 Central Ave., Detroit

Regulating Valves For Every Service

On request we will send this Atlas Junior Catalog No. 21 to any Heating and Ventilating Engineer. It is devoted entirely to our Regulating Valves and Devices. In which of the following are you interested?

- ☐ Reducing Valves
- ☐ Temperature Regulators
- ☐ Damper Regulators
- ☐ Pump Governors
- ☐ Float Valves
- ☐ Boiler Feed Water Regulators
- ☐ Swing Joint Fittings
- ☐ Bronze Unions
- ☐ Thermostats
- ☐ Balanced Valves

ATLAS VALVE COMPANY
REGULATING VALVES FOR EVERY SERVICE
281 South Street, Newark, N.J.



1/30 to
½ h. p.

A Complete Line of FAN DUTY Motors

Interchangeable Throughout

EMERSON Fan Duty Motors are specially designed for fan duty service. The Line is complete including the following types to provide for variation in production requirements. All frames are interchangeable—equipped either with ball or sleeve bearings.

Single Phase, Single-Speed
Single Phase, 2-Speed
Speed ratio 2 to 1
Speed ratio 3 to 2
Single Phase, 3-Speed Capacitor
Polyphase, Single-Speed
Polyphase, 3-Speed Bank Control
DC Single or Variable Speed

Write for Bulletin

THE EMERSON ELECTRIC MFG. COMPANY
2018 Washington Ave., Saint Louis
806 W. Washington Blvd., Chicago
155 Sixth Avenue., New York City

EMERSON
FAN DUTY
MOTORS

THERMO SYPHON TRAP

"PLAY SAFE"

ON ALL TYPES OF STEAM HEATING SYSTEMS

LENGTHEN the life of your boiler by installing a Thermo Syphon Trap. It prevents cracking or burning, by returning all condensation to the boiler, regardless of pressure or vacuum. It checks air-bound or water-log conditions, thus adding new life to your heating system.

Thermo Syphon Trap is especially designed for one- or two-pipe steam heating systems with a vacuum or pressure not exceeding 20 pounds on the boiler. Thermo Syphon Traps are used with success on prominent patented Vapor, Vacuum, Atmospheric and Modulation systems.

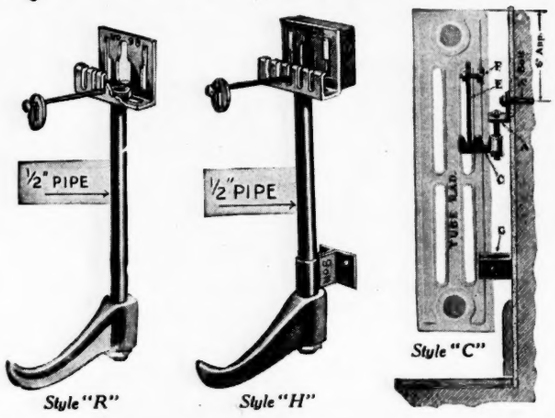
Send for Bulletin No. 16 - H. V. giving full details.

LYTTON
MANUFACTURING CORPORATION

FRANKLIN VIRGINIA

E-Z RADIATOR HANGERS

for ALL Radiators



Install radiators this modern way—hang them from the wall with E-Z RADIATOR HANGERS. 3 styles meet any and all conditions. Fully adjustable both horizontally and vertically. Easily and quickly installed in any kind of wall material. Leading architects and contractors recommend and use them. Write for complete information.

HEALY-RUFF CO.

772 Hampden Avenue, St. Paul, Minn.

Also Manufacturers of E-Z INSERTS and E-Z LAVATORY HANGERS

Wherever a beautiful grille is indicated . . . architects now choose Metalace for its distinguished decorative effect.

Grilles of bronze, of chromium plate or of steel lacquered in colors, enhance the architectural setting. Strands may be of any size or any combination desired.

For banks, offices, stores, dwellings, hotels—anywhere that beauty and dignity prevail—you will find that Metalace solves the problems of wall openings, partitions and enclosures.

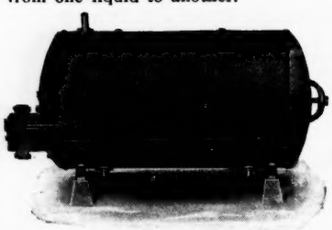
Write for samples and catalog

METALACE

The Metalace Corporation, South Boston, Mass.

Alberger Buffalo Heaters

are built for a great variety of standard and special operating conditions for heating water with steam or for the interchange of heat from one liquid to another.



Instantaneous Heaters
Storage Heaters
Swimming Pool Heaters
Economizers
Coolers
Heat Interchangers

ALBERGER HEATER CO. 285 Chicago St.
HOWARD IRON WORKS Buffalo, N. Y.

SERVICE ...

As We Understand It.

HEATERS
RECLAIMERS
COOLERS
EXCHANGERS
CONDENSERS

First of all, an intelligent understanding of your heat transfer problem. Then the knowledge, experience and ability to design equipment to completely solve that problem. And last, but not least, the highest standards of quality in materials and workmanship in construction.

O. E. FRANK HEATER & ENGINEERING CO., INC.
20 MILBURN STREET
BUFFALO, N. Y.

OEF BUFFALO Otto E. Frank

Service The *Satisfaction*

VECO SYSTEM of VAPOR HEATING

An "Open to atmosphere" System.
The original and standard method ot
Vapor Heating

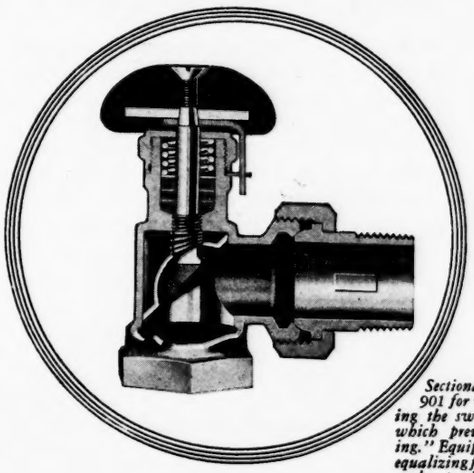
VAPOR ENGINEERING COMPANY

PHILADELPHIA—10 So. 18th Street NEW YORK—489 Fifth Avenue

13 CONTRACTORS
(OF COLUMBUS)

standardize on

ARCO PACKLESS
RADIATOR VALVES



Sectional view of No. 901 for water, showing the swinging plate which prevents "sticking." Equipped with the equalizing feature which makes possible "balancing" of the flow, after installation.

Return trips to repack leaking radiator valves not only cost you money and time, but owners blame you for a faulty installation.

When you install Arco Packless Valves you are insuring not only your profits but your reputation as well, and you add less than the expense of one trip to the cost of the job. That is why, in the city of Columbus alone, there are 13 contractors who use Arco Packless Valves regularly on all jobs.

•

Standardize on Arco Packless
No. 999 for Steam No. 901 for Water
A complete line of Packless Valves for steam, water, vapor or vacuum. Made in Angle, Corner, Globe and Gate patterns

AMERICAN RADIATOR COMPANY
DIVISION OF
AMERICAN RADIATOR & STANDARD SANITARY CORPORATION
40 WEST 40TH STREET, NEW YORK

ARCO ACCESSORIES MAKE ANY HEATING PLANT BETTER

NEW HEATING ECONOMY

This large blower type unit heater has the capacity of many smaller heating units, simplifies piping and greatly reduces cost of installation — increases the capacity of any heating plant by reducing piping losses — provides definite temperature control.

Torrid-Aire
Blower Type Unit Heater

AIR taken in by the blower is driven under controlled velocity through the copper heating element. Then the patented Dual Deflector distributes the air in 64 directions as desired.

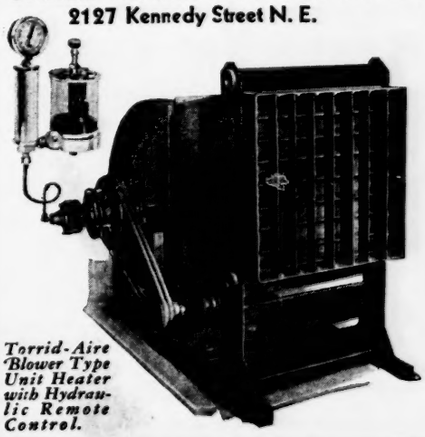
Suspended from ceiling or placed on floor. Has exclusive Hydraulic Remote Control for ample range of blower speeds; control placed where convenient.

Leakproof Core. No soldering or brazing. The design of the tubes and the special union between tubes and headers eliminate seam separation and blowouts. The SAFE unit heater.

Ideal Summer Cooling. In hot weather large volumes of outside air can be taken in and distributed under high velocity to all parts of the room, providing a brisk, cooling circulation. Torrid-Aire is better for summer as well as winter.

The U. S. Complete Line includes single and double inlet blowers, air washers, unit heaters and blower type heaters.

UNITED STATES BLOWER AND HEATER CORP.
2127 Kennedy Street N. E. Minneapolis, Minn.



Torrid-Aire Blower Type Unit Heater with Hydraulic Remote Control.

Write for our new catalog

BURKS SUPER-TURBINE PUMPS

CONDENSATION RETURN UNITS

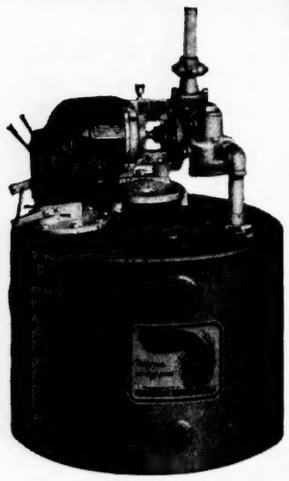
"High and Dry"

No need to subject your Condensation Pump to the dirt, grease, and water usually found in the boiler room sump or pit. Powerful suction, even when handling HOT water, enables the Burks Super-Turbine pump to perform effectively when mounted on TOP of the receiver tank.

Will Not Steam-bind

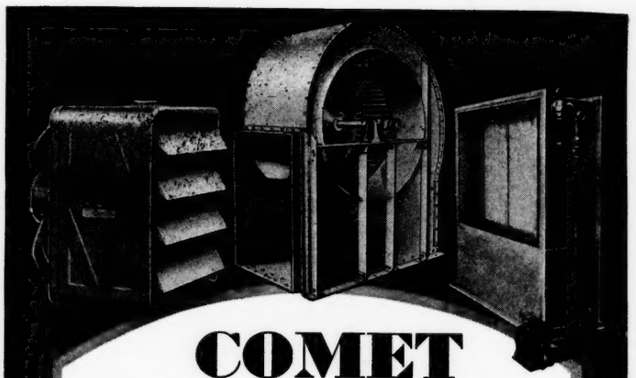
Only one moving part—the impeller. Pumps air alone to full pressure rating of the pump, hence will not steam-bind. Investigate this outstanding pump.

Send for Bulletin No. 91, which describes this new Condensation Return Unit fully. Write today.



SERIES 4700

DECATUR PUMP COMPANY DECATUR, ILLINOIS



COMET Unit Heaters

When the heating equipment you propose to use on your job has a record of thousands of successful installations behind it, you can rely upon it to be just as successful on yours. ¶ New York Blower Products have certified ratings and a durability record that is beyond question.

For descriptive literature write to 3151 Shields Avenue, Chicago.

The NEW YORK BLOWER COMPANY

New STAT-AMATIC CATALOG

Tells how Stat-Amatic is solving unlimited problems of heat control and temperature regulation including its great value in connection with Unit Heaters.

You should have this catalog HV13.

Stat-Amatic Intrument & Appliance Co.
HARTFORD, CONN.

OHIO MOTORS

meet all N. E. M. A. and N. E. L. A. specifications. They are available in sizes from 1/30 to 1 horsepower.

Ball Bearings or Sleeve Bearings.

Send for Bulletin

The Ohio Electric Mfg. Co.
5912 Maurice Avenue Cleveland, Ohio

More Heat—Yet Fuel Bills Are Lower!

A JANETTE HYDROLATOR installed on a hot water heating job forces water to *every* radiator at a speed many times greater than ordinary thermal circulation, giving the entire system more heat—and the fuel cost is lower!

Water temperatures at the boiler are kept lower, thus the water has greater heat absorption.

The HYDROLATOR pays for itself in fuel savings alone!

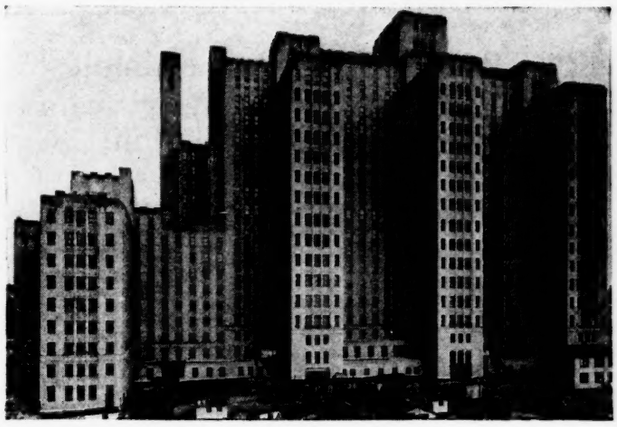
Write for further information

JANETTE MANUFACTURING CO.
556-58 West Monroe Street
Chicago, Ill.

149 Broadway, Singer Bldg., New York, N. Y.

Real Estate Trust Bldg., Philadelphia, Pa.

Harrison Sales Co., 314 Ninth Ave. N., Seattle, Wash.



Largest Hospital Should Save $18,000 a Year!

Tests show that the average person inhales more than a tablespoonful of dust every 24 hours, much of which contains dangerous disease germs. Think how important clean air is, especially in hospitals!

Not only could the Columbia Presbyterian Medical Center supply patients with clean air to breathe, but it is estimated that they could save well over $18,000 a year in cleaning bills by installing Protectomotor Panel Air Filters.

Cleaning bills can be materially reduced in every type of building by eliminating dirty air—so can the cost of redecorating, repainting and refurnishing.

PROTECTOMOTOR

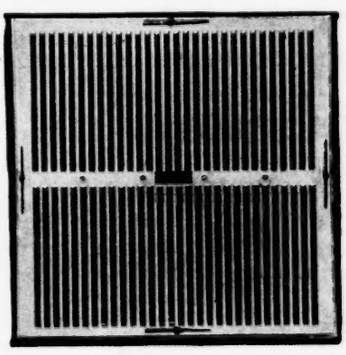
REG. U. S. PAT. OFF.

Perfect Positive Protection

PANEL AIR FILTER

removes 999 of every 1,000 particles of dust, dirt and soot from the air. Makes it clean and healthful.

The first cost of this air filter is low. And the operating cost is practically nothing. There is no viscous coating to remove and renew frequently, no expense for labor and material used in coating, no panels to remove, no expensive apparatus required for cleaning.



It can be cleaned in about half a minute per panel with a vacuum cleaner and cleaning is only necessary about every two months.

Write for our interesting catalog.

See our Exhibit Booths 419-420 Power Show

STAYNEW FILTER CORP.

15 Leighton Avenue, ROCHESTER, N. Y.

IF ECONOMY IS IMPORTANT RIC-WIL IS ESSENTIAL

Because Ric-wiL Conduit is the economical system for the protection and insulation of underground steam pipes. Ric-wiL Conduit is easy and economical to install—It requires less trenching, less extra materials and no special construction.

But the real economy lies in the efficiency and permanence of Ric-wiL Conduit. Ric-wiL Conduit Systems are so well engineered and of such sturdy construction that there is no time limit to their efficiency or permanence. Once installed, Ric-wiL Conduit can be depended upon indefinitely. Thus with Ric-wiL the first cost is the *last* cost—you'll have no yearly replacements or repairs—no lowered efficiency—no staggering after costs.

High efficiencies are a habit with Ric-wiL—test after test of various Ric-wiL installations have shown better than 90%, and a recent test showed 95.6%. And Ric-wiL holds heat losses decidedly lower than can be expected from ordinary conduit.

Ric-wiL Engineers, with over twenty years experience, are at your service. Whatever your problem, they can solve it to your complete satisfaction, both as to economy and efficiency. Write for the Ric-wiL Catalog and Detail Sheets of typical installations.

7 Ric-wiL Advantages

1. *Base Drain foundation, safe, adequate, immediate drainage.*
2. *Loc-liP Side Joint, a water-tight seal which locks top and bottom halves together.*
3. *External Pipe Supports, rigid, strong, quickly installed.*
4. *Four types of insulation including Dry-paC, to meet every condition.*
5. *Cast Iron Ric-wiL to eliminate expensive special concrete construction.*
6. *Strong, compact interlocking construction throughout.*
7. *Less trenching, less extra materials, no special construction and such easy rapid assembling in the trench that the installed cost of Ric-wiL is often less than ordinary conduit.*

THE RIC-WIL COMPANY

1562 Union Trust Building . . . Cleveland, Ohio

Branches: New York · Baltimore · Atlanta · Chicago

AGENTS IN PRINCIPAL CITIES

REG. U. S. PAT. OFF.

RIC-WIL

UNDERGROUND CONDUIT FOR STEAM PIPES

A GOOD BOILER RETURN TRAP will provide the simplest and best means of returning condensation to an ordinary steam heating boiler where equipment has little or no attention.

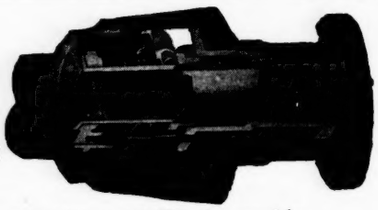
A cheap trap of ordinary construction will sooner or later fail — a broken boiler—that's all.

The Simplex "Valve in the Head" trap with bronze and nickel steel valves and working parts is a distinctly superior piece of equipment built for lifetime service.

Send us your next order, pay the small difference and let experience be your guide.

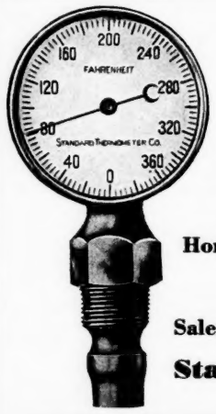
SIMPLEX HEATING SPECIALTY CO., Inc.
LYNCHBURG, VIRGINIA

ROSS
Crosshead-GUIDED Expansion Joint Excels in



Design, Construction and Workmanship
Over 60% of sales—Repeat Orders
Once Used—Always Demanded
Every Purchaser—A Customer

ROSS HEATER & MFG. CO., INC., BUFFALO, N. Y.
New York, Chicago, Philadelphia, Boston, Cleveland, St. Louis, Detroit, Pittsburgh, Baltimore, San Francisco, Seattle, Denver, Salt Lake City, Omaha, Montreal, Toronto.



STANDARD MECHANICAL THERMOMETERS

Quality for Over 45 Years for all Hot Water and Steam Services

Horizontal or Vertical types Fahrenheit and Centigrade Scales

Write or Wire

Sales Engineers, write us for representation

Standard Thermometer, Inc.
Boston, 19, Mass.

BRYAN Copper Tube BOILERS

Built Especially for Oil or Gas Burning

BRYAN STEAM CORPORATION
Boiler Division - Peru, Indiana

Gar-Wood

BALANCED HEATING UNIT

Write today for a copy of new FREE book, "A New Principle of Generating Heat at Low Cost."
Responsible organizations now distributing through the heating trade should investigate the Gar-Wood franchise. Write the factory for details.

GAR WOOD ENGINEERING CO.
4196 Bellevue Avenue Dept. H-12 Detroit, Michigan

United States Ozone Company of America

SCOTTDALE, PENNA.
(Business Established 1910)

Trade Mark
USOZONE
Reg. U.S. Pat. Office

Ozone and Electrolytic Water Sterilizers
Ozone Air Conditioning Equipment
Industrial Ozonizers

This Company Controls "U. S. Ozone Company Pennsylvania Charter 1920"

We shall be glad to send you Complete Information and Engineering Data.

MASTER HEAT REGULATOR

TYPE 44

Super-Automatic

—operates gradually

TYPE 44
Gradual Operation

ROOM temperature fluctuations are cut down to a new minimum by the Master Heat Regulator, Type 44. This super-automatic instrument operates valves or dampers *gradually*, just as actually required. Only the MASTER has this feature giving the closest possible regulation.

Thermostat shows position of valves or dampers at all times, indicating condition of fire. Full-Electric, eight-day jewelled clock or plain models.

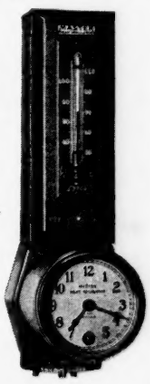
TYPE 22

This instrument meets the demand for a popular-priced regulator of flawless quality and performance. Full-Electric, eight-day jewelled clock model $80.00. Same, without clock control, $55.00. All models are full electric.

Contractors and Dealers: Write for complete information and discounts.

Use W-M-C Water Thermostats

For hot water heating systems—accurate, dependable, inexpensive. Easily installed without drawing boiler or interfering with fire. Write for details.



TYPE 22
Full Electric 8-Day Jewelled clock model **$80**

TYPE 22
Full Electric without clock control **$55**

White Mfg. Co.

2362 University Ave.
St. Paul, Minnesota

Rusty Water is DOLLAR DUST Washed Away

MONEY filings—that's what rust is. Bits of metal that the action of water bites off the inside of steel hot water heaters.

Eventually rust eats holes in the shell; then a new heater is required.

Patterson

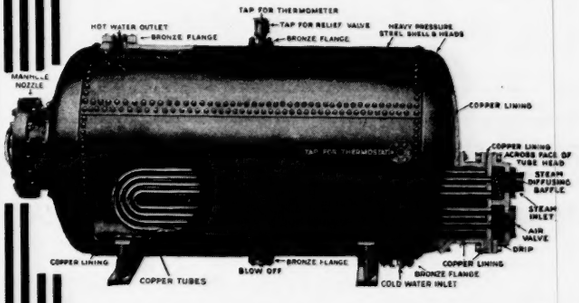
Indestructo COPPER LINED Hot Water Heater

is a *permanent* investment because it is lined throughout with copper, and cannot rust. It is practically everlasting.

The Patterson Indestructo is *guaranteed* to prevent discoloration of water from rust.

Our catalog will interest you. The coupon will bring it.

THE PATTERSON-KELLEY CO.
107 East 40th St., New York City



THE PATTERSON-KELLEY CO.,
107 East 40th St., New York City.

Without obligation on our part, please send a copy of your catalog on Patterson Indestructo Heaters.

Name.....

Address.....

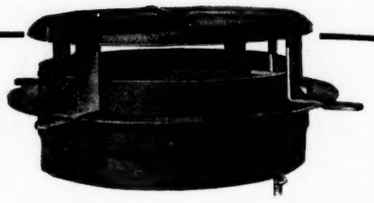
Town.....State.....

USE

UTILITY
STRENGTH
ECONOMY

Samples and Literature Sent on Request

KNOWLES AEROVALVE
Mushroom Air Diffuser



Read These Features:

1. A Solid Unit which cannot be taken apart. Quickly installed in **ONE PIECE** to either wood or concrete floor.
2. Finest adjustment from wide open to completely closed by screw on **TOP OF CAP.**
3. Heavier Cap Supports which bear **DIRECTLY** across full width of one-inch floor flange of mushroom and floor.
4. Improved damper construction affording free area.
5. Simple yet positive locking member affording absolute **SILENCE.**
6. The Aerovalve is in a class of its own because of its **STRENGTH, UTILITY** and **ECONOMY.**

KNOWLES MUSHROOM VENTILATOR CO., 41 N. Moore St., NEW YORK CITY

THE BARBER-COLMAN ELECTRIC SYSTEM OF TEMPERATURE CONTROL

BARCOL

Low first cost, low operating cost, ease of installation, adaptability and complete dependability are some of the outstanding advantages of this Electric System of Temperature Control. Write for complete information today.

BARBER-COLMAN COMPANY
ROCKFORD, ILLINOIS

BALDOR

A BETTER BALL BEARING MOTOR

Eliminates Thrust and Lubrication Problems

Specializing for eleven years in ball-bearing designed motors. All sizes and current characteristics. Also matched frame motors.

BALDOR ELECTRIC COMPANY
4356 Duncan Avenue ST. LOUIS, MO., U. S. A.

CENTRAL STATION STEAM CO.
2912 East Woodbridge St.
DETROIT, MICHIGAN

MANUFACTURERS OF

Cadillac Condensation Meters
Detroit Feed Water Meters

Packingless Expansion Joints and other special fittings for underground steam distribution mains.

McALEAR

McAlear No. 175 Pressure Regulating Valve.

Get the answer to YOUR regulating problems by writing for the special Sections of Catalog 30, devoted to your pressure or level control problems for steam, water, gas, air or oil. They contain practical information, applications, blue prints and much valuable information. Write TODAY.

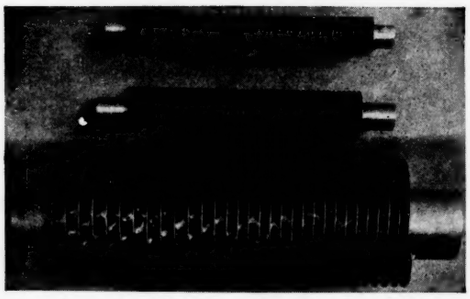
THE McALEAR MFG. CO.
1901-07 S. Western Ave. - Chicago
Sales Engineers in all Principal Cities

S&K Radiafin Tubes stand pressures up to 250 lbs.

They are made in brass, copper or steel. Sizes ½" to 3".

S & K Radiafin Pipes, for pressures up to 125 lbs., are made in sizes ⅜" to 6"

The fins increase the effective heat transfer surface



SCHUTTE KOERTING

Send for data sheet

1153 Thompson Street
Philadelphia, Pa.

See these tubes at N. Y. Power Show, Booth 342

The FITZGIBBONS LINE of STEEL HEATING & POWER BOILERS

for ALL FUELS and ALL HEATING SYSTEMS in Installations of EVERY SIZE

COPPER-STEEL RESIDENCE BOILERS—TABLE 1

for Small and Medium Size Plants. Electric Welded. Built for 15 lbs. W.S.P. types for Anthracite, Bituminous Coals or Coke, Oil, Gas, Domestic Stokers. 400 to 4000 sq. ft. Steam Ratings.

STEEL HEATING BOILERS—TABLE 2

for Intermediate Size Heating Plants. Riveted Longitudinal Seams. 15 lbs. W.S.P. types for All Fuels. 3800 to 25000 sq. ft. Steam Ratings.

STEEL HEATING AND POWER BOILERS—TABLE 3

for heating large buildings of every description, including those having kitchen, laundry, process and similar high-pressure loads. All-Riveted construction. Types for All Fuels. Heating Boilers for 15 lbs. W.S.P. Power Boilers up to 150 lbs. W.S.P. 4200 to 36000 sq. ft. Steam Ratings.

Z-U FIREBOX BOILERS

Smokeless, Up-Draft, Oil, Gas, Stoker Types. 2300 to 38000 sq. ft. Steam Ratings. Built for 15 lbs. W.S.P.

R-Z-U FIREBOX BOILERS

Rear Smoke Outlet. The Z-U Boiler arranged to meet the needs of plants where conditions make it desirable to place smoke outlet at the rear. 4000 to 34000 sq. ft. Steam Ratings. Built for 15 lbs. W.S.P.

500-SERIES PORTABLE FIREBOX BOILERS

Riveted — Return Tubular. 5900 to 37000 sq. ft. Steam Ratings. Built for 15 and 100 lbs. W.S.P.

SMOKELESS, DOWN-DRAFT FIREBOX BOILERS

Riveted — Return Tubular. Designed primarily for burning soft coal smokelessly, but also adapted for burning any other fuel as well. 7000 to 27000 sq. ft. Steam Ratings. Built for 15 and 100 lbs. W.S.P.

WRITE FOR DESCRIPTIVE LITERATURE

FITZGIBBONS BOILER CO., Inc.
570 Seventh Ave. NEW YORK, N. Y.
***Works:* OSWEGO, N. Y.**
Branches and Representatives in Principal Cities

The Stack No-Tank

Approved by the Underwriters' Laboratories

No More Expansion Tanks on Hot Water House-Heating Systems

EFFICIENT - - ECONOMICAL

Ask your Jobber and write us for Catalog No. 34

ESTABLISHED 1894

THE STACK HEATER COMPANY

BALL COCKS
INDIRECT HEATERS
GAS WATER HEATERS
HEAT INTERCHANGERS
HOT WATER GENERATORS

STACK PRODUCTS

RELIEF VALVES
NO-TANK VALVES
NONBIPAS VALVES
STEAM WATER MIXERS
PRESSURE REDUCING VALVES

TWO HUNDRED AND FIFTY STUART STREET
BOSTON

No Other Relief Valve has this *Important* Watts Feature

Watts Relief Valves are calibrated so that they can be set in field for different pressures. This eliminates the necessity of using a pressure gauge for resetting.

These valves have a 3-ply laminated diaphragm — two plies of phosphor bronze and one of Monel metal—attached to a Jenkins disc by a water-tight cap and screw. The diaphragm disc is on the ceiling of the valve, away from the flow of water. There are no soldered or loose parts to get out of place.

Pressure Relief Valve for Range Boilers

Watts Relief Valves have about 16 times more effective area for opening the valve than in corresponding pop relief valves. That, together with the fact that Watts Valves have no guide wings to stick or bind, eliminates the possibility of the valve becoming inoperative.

Watts Valves can be made absolutely drip tight. They are listed as standard by the Underwriters' Laboratories.

Write for Catalog No. 28.

WATTS REGULATOR CO., 253 Lowell Street LAWRENCE, MASS.
Makers of Water and Steam Regulating Devices Since 1874
John G. Kelly, Inc., U. S. Sales Associates
210 E. 45th St., New York, N. Y.
W. H. Cunningham & Hill, Ltd., 269 Richmond St., Toronto, 2, Canada

WATTS **DIAPHRAGM RELIEF VALVES**

The Leitner Building has McDermott Heaters

Le Roy P. Ward, Inc., New York City,
Architects.
Albert Fentzlaff, New York City,
Consulting Engineer.
Friedman & Kiss, Inc., New York City,
Heating Contractors.
Richard Tretler, New York City,
Plumbing Contractor.

McDermott Heaters are installed in Heggie-Simplex Boilers

New York coal dealers, by contract, guarantee a saving up to 50% annually, upon your investment in McDermott heaters. Could there be better evidence that McDermott heaters pay you for paying for them?

Specializing to Do One Thing Better

McDERMOTT WATER HEATERS, INC.

101 Park Avenue
Architects Building New York City

ENGINEERS' SPECIFICATION INDEX

AIR COMPRESSORS
American Steam Pump Co., Battle Creek, Mich
Bishop & Babcock Sales Co., Cleveland, Ohio.
Janette Mfg. Co., Chicago, Ill.
Johnson Service Co., Milwaukee, Wis.
Nash Engineering Co., So. Norwalk, Ct.
Powers Regulator Co., Chicago, Ill.

AIR CONDITIONING APPARATUS
American Air Filter Co., Louisville, Ky.
Bayley Blower Co., Milwaukee, Wis.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Carrier Engineering Corp., Newark, N. J.
Grinnell Co., Providence, R. I.
Johnson Service Co., Milwaukee, Wis.
Lewis Corp., Minneapolis, Minn.
New York Blower Co., Chicago, Ill.
Niagara Blower Co., New York, N. Y.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
U. S. Blower & Heater Corp., Minneapolis, Minn.
U. S. Ozone Corp., Scottdale, Penn.

AIR COOLING & DRYING SYSTEMS
American Air Filter Co., Louisville, Ky.
Bayley Blower Co., Milwaukee, Wis.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Buffalo Forge Co., Buffalo, N. Y.
Carrier Engineering Corp., Newark, N. J.
Johnson Service Co., Milwaukee, Wis.
National Regulator Co., Chicago, Ill.
New York Blower Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
U. S. Blower & Heater Corp., Minneapolis, Minn.

AIR ELIMINATORS
Bishop & Babcock Sales Co., Cleveland, Ohio.
Hoffman Specialty Co., New York.
Marsh & Co., Jas. P., Chicago, Ill.
Sarco Co., Inc., New York.
Sterling Engineering Co., Milwaukee, Wis.

AIR FILTERS
American Air Filter Co., Louisville, Ky.
Staynew Filter Corp., Rochester, N. Y.

AIR SEPARATORS
Bishop & Babcock Sales Co., Cleveland, Ohio.

AIR WASHERS
Bayley Blower Co., Milwaukee, Wis.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Buffalo Forge Co., Buffalo, N. Y.
Carrier Engineering Corp., Newark, N. J.
New York Blower Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
U. S. Blower & Heater Corp., Minneapolis, Minn.

BELTING
Alexander Bros., Inc., Philadelphia, Pa.

BLOWERS
Bayley Blower Co., Milwaukee, Wis.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Buffalo Forge Co., Buffalo, N. Y.
New York Blower Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
U. S. Blower & Heater Corp., Minneapolis, Minn.
Wing Mfg. Co., L. J., New York.

BLOWERS, FAN
(See Fans, Supply & Exhaust).

BOILER CEMENT
Johns-Manville Corp., New York, N. Y.

BOILERS, COPPER
The Stack Heater Co., Boston, Mass.

BOILERS, HEATING, CAST-IRON, COAL BURNING
American Radiator Co., New York, N. Y.
Burnham Boiler Corp., Irvington, N. Y.
Illinois Malleable Iron Co., Chicago, Ill.
H. B. Smith Co., Westfield, Mass.
Weil-McLain Co., Chicago, Ill.

BOILERS, HEATING, DOWN-DRAFT, COAL BURNING
American Radiator Co., New York, N. Y.
Brownell Co., The, Dayton, Ohio.
Coatesville Boiler Works, Phila., Pa.
Kewanee Boiler Corp., Kewanee, Ill.
Pacific Steel Boilers Corp., Waukegan, Ill.
Stanwood Corporation, Cincinnati, O.
Titusville Iron Wks. Co., Titusville, Pa.

BOILERS, HEATING, GAS-FIRED
American Radiator Co., New York, N. Y.
Bryan Steam Corp., Peru, Ind.
Gar Wood Engineering Co., Detroit, Mich.

BOILERS, HEATING, OIL-FIRED
American Radiator Co., New York, N. Y.
Brownell Co., The, Dayton, Ohio.
Bryan Steam Corp., Peru, Ind.
Burnham Boiler Corp., Irvington, N. Y.
Coatesville Boiler Works, Phila., Pa.
Fitzgibbons Boiler Co., Inc., New York.
Frost Mfg. Co., Galesburg, Ill.
Heggie-Simplex Boiler Co., Joliet, Ill.
Illinois Malleable Iron Co., Chicago, Ill.
Johnston Bros. Inc., Ferrysburg, Mich.
Kewanee Boiler Corp., Kewanee, Ill.
Monitor Boiler Co., Philadelphia, Pa.
Pacific Steel Boiler Corp., Waukegan, Ill.
H. B. Smith Co., Westfield, Mass.
Stanwood Corp., Cincinnati, O.
Titusville Iron Wks. Co., Titusville, Pa.
Gar Wood Engineering Co., Detroit, Mich.
Weil-McLain Co., Chicago, Ill.

BOILERS, HEATING, STEEL, COAL-FIRED
Brownell Co., The, Dayton, Ohio.
Coatesville Boiler Wks., Coatesville, Pa.
Fitzgibbons Boiler Co., Inc., New York.
Frost Mfg. Co., Galesburg, Ill.
Heggie-Simplex Boiler Co., Joliet, Ill.
Johnston Bros., Inc., Ferrysburg, Mich.
Kewanee Boiler Corp., Kewanee, Ill.
Monitor Boiler Co., Philadelphia, Pa.
Pacific Steel Boilers Corp., Waukegan, Ill.
Stanwood Corporation, Cincinnati, O.

BOILERS, POWER
Coatesville Boiler Works, Phila., Pa.
Fitzgibbons Boiler Co., Inc., New York.
Frost Mfg. Co., Galesburg, Ill.
Stanwood Corporation, Cincinnati, O.
Titusville Iron Wks. Co., Titusville, Pa.

CIRCULATORS, WATER
Janette Mfg. Co., Chicago, Ill.

COILS, PIPE
Bayley Blower Co., Milwaukee, Wis.
Buffalo Forge Co., Buffalo, N. Y.
Crane Co., Chicago, Ill.
Whitlock Coil Pipe Co., Hartford, Conn.

CONDENSERS
Frank Heater & Engineering Co., O. E., Buffalo, N. Y.
Ross Heater & Mfg. Co., Buffalo, N. Y.
Schutte & Koerting Co., Philadelphia, Pa.
Whitlock Coil Pipe Co., Hartford, Conn.

CONDENSERS FOR REFRIGERATORS, COPPER
Wolverine Tube Co., Detroit, Mich.

CONDUITS, UNDERGROUND PIPE
Johns-Manville Corp., New York, N. Y.
Ric-wiL Co., The, Cleveland, Ohio.

CONVERTERS, HOT WATER
Frank Heater & Engineering Co., O. E., Buffalo, N. Y.
Ross Heater & Mfg. Co., Buffalo, N. Y.
Whitlock Coil Pipe Co., Hartford, Conn.

COOLERS, AIR
Alberger Heater Co., Buffalo, N. Y.
Frank Heater & Engineering Co., O. E., Buffalo, N. Y.

COOLERS, OIL
Ross Heater & Mfg. Co., Buffalo, N. Y.
Schutte & Koerting Co., Philadelphia, Pa.
Whitlock Coil Pipe Co., Hartford, Conn.

COOLING TOWERS & PONDS
Buffalo Forge Co., Buffalo, N. Y.
Ross Heater & Mfg. Co., Buffalo, N. Y.
Schutte & Koerting Co., Philadelphia, Pa.

COVERING, BOILER, PIPE, ETC.
Crane Co., Chicago, Ill.
General Insulating & Mfg. Co., Alexandria, Ind.
Johns-Manville Corp., New York, N. Y.
Ric-wiL Co., The, Cleveland, Ohio.

DAMPER REGULATORS
(See Regulators, Damper)

DAMPERS, DUCT
Barber-Colman Co., Rockford, Ill.
National Regulator Co., Chicago, Ill.

DEHUMIDIFYING APPARATUS
Bayley Blower Co., Milwaukee, Wis.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Buffalo Forge Co., Buffalo, N. Y.
Carrier Engineering Corp., Newark, N. J.
Johnson Service Co., Milwaukee, Wis.
New York Blower Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Wing Mfg. Co., L. J., New York.

DISTILLERS (WATER)
Ross Heater & Mfg. Co., Buffalo, N. Y.
Schutte & Koerting Co., Philadelphia, Pa.

DRAFT APPLIANCES, MECHANICAL
Bayley Blower Co., Milwaukee, Wis.
Buffalo Forge Co., Buffalo, N. Y.
National Regulator Co., Chicago, Ill.
New York Blower Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Wing Mfg. Co., L. J., New York.

DRYING SYSTEMS
(See Air Cooling & Drying Systems).

DUST COLLECTING SYSTEMS
American Air Filter Co., Louisville, Ky.
Bayley Blower Co., Milwaukee, Wis.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Buffalo Forge Co., Buffalo, N. Y.

DUST COLLECTORS
Buffalo Forge Co., Buffalo, N. Y.
Carrier Engineering Corp., Newark, N. J.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

ENGINES, STEAM
Brownell Co., The, Dayton, Ohio.
Frost Mfg. Co., Galesburg, Ill.
Stanwood Corp., Cincinnati, O.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

EQUALIZING LOOPS
Hoffman Specialty Co., New York.
Sarco Co., Inc., New York.

EVAPORATORS, BOILER FEED MAKE-UP
Buffalo Forge Co., Buffalo, N. Y.
Ross Heater & Mfg. Co., Buffalo, N. Y.
Schutte & Koerting Co., Philadelphia, Pa.

EXHAUST HEADS
Crane Co., Chicago, Ill.
Illinois Engineering Co., Chicago, Ill.
Kieley & Mueller, Inc., New York.
McAlear Mfg. Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

EXHAUST FANS & SYSTEMS
Bayley Blower Co., Milwaukee, Wis.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Buffalo Forge Co., Buffalo, N. Y.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
U. S. Blower & Heater Corp., Minneapolis, Minn.
Wing Mfg. Co., L. J., New York.

EXPANSION JOINTS
Alberger Heater Co., Buffalo, N. Y.
Badger & Sons Co., E. B., Boston, Mass.
Central Station Steam Co., Detroit, Mich.
Crane Co., Chicago, Ill.
Hornung, J. C., Chicago, Ill.
Illinois Engineering Co., Chicago, Ill.
Ross Heater & Mfg. Co., Buffalo, N. Y.
Webster & Co., Warren, Camden, N. J.

FANS, CENTRIFUGAL
Bayley Blower Co., Milwaukee, Wis.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Buffalo Forge Co., Buffalo, N. Y.
New York Blower Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
U. S. Blower & Heater Corp., Minneapolis, Minn.
Wing Mfg. Co., L. J., New York.

FANS, DISC
Bayley Blower Co., Milwaukee, Wis.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Buffalo Forge Co., Buffalo, N. Y.
New York Blower Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Wing Mfg. Co., L. J., New York.

FANS, MULTI-BLADE
Bayley Blower Co., Milwaukee, Wis.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Buffalo Forge Co., Buffalo, N. Y.
New York Blower Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
U. S. Blower & Heater Corp., Minneapolis, Minn.
Wing Mfg. Co., L. J., New York.

FANS, PROPELLER
Bayley Blower Co., Milwaukee, Wis.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Buffalo Forge Co., Buffalo, N. Y.
Emerson Electric Mfg. Co., St. Louis, Mo.
New York Blower Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Wing Mfg. Co., L. J., New York.
Young Radiator Co., Racine, Wis.

FANS, STEEL PLATE
Bayley Blower Co., Milwaukee, Wis.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Buffalo Forge Co., Buffalo, N. Y.
New York Blower Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

FEEDERS, BOILER
Kieley & Mueller, Inc., New York.
McAlear Mfg. Co., Chicago, Ill.
McDonnell & Miller, Chicago, Ill.
The Stack Heater Co., Boston, Mass.
Watts Regulator Co., Lawrence, Mass.

FEEDERS, WATER, STEAM BOILER
Kieley & Mueller, Inc., New York, N. Y.
McDonnell & Miller, Chicago, Ill.

FITTINGS, ACID RESISTING
Crane Co., Chicago, Ill.

FITTINGS, PIPE, FLANGED
Crane Co., Chicago, Ill.
Grinnell Co., Providence, R. I.
Illinois Malleable Iron Co., Chicago, Ill.

FITTINGS, PIPE, SCREWED
Crane Co., Chicago, Ill.
Grinnell Co., Providence, R. I.
Illinois Malleable Iron Co., Chicago, Ill.

FLANGES
Crane Co., Chicago, Ill.
Illinois Malleable Iron Co., Chicago, Ill.
Jenkins Bros., New York.

GASKETS, ASBESTOS
Crane Co., Chicago, Ill.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Jenkins Bros., New York.
Johns-Manville Corp., New York, N. Y.

GASKETS, METALLIC
Crane Co., Chicago, Ill.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Jenkins Bros., New York.

GASKETS, RUBBER
Crane Co., Chicago, Ill.
Goetze Gasket & Packing Co., New Brunswick, N. J.
Jenkins Bros., New York.

GAUGE BOARDS
Bishop & Babcock Sales Co., Cleveland, Ohio.
Marsh & Co., Jas. P., Chicago, Ill.

GAUGE GLASSES
Crane Co., Chicago, Ill.
Jenkins Bros., New York.

GAUGES, ALTITUDE
American Radiator Co., New York, N. Y.
Bristol Co., The, Waterbury, Conn.
Marsh & Co., Jas. P., Chicago, Ill.
Mercoid Corporation, Chicago, Ill.

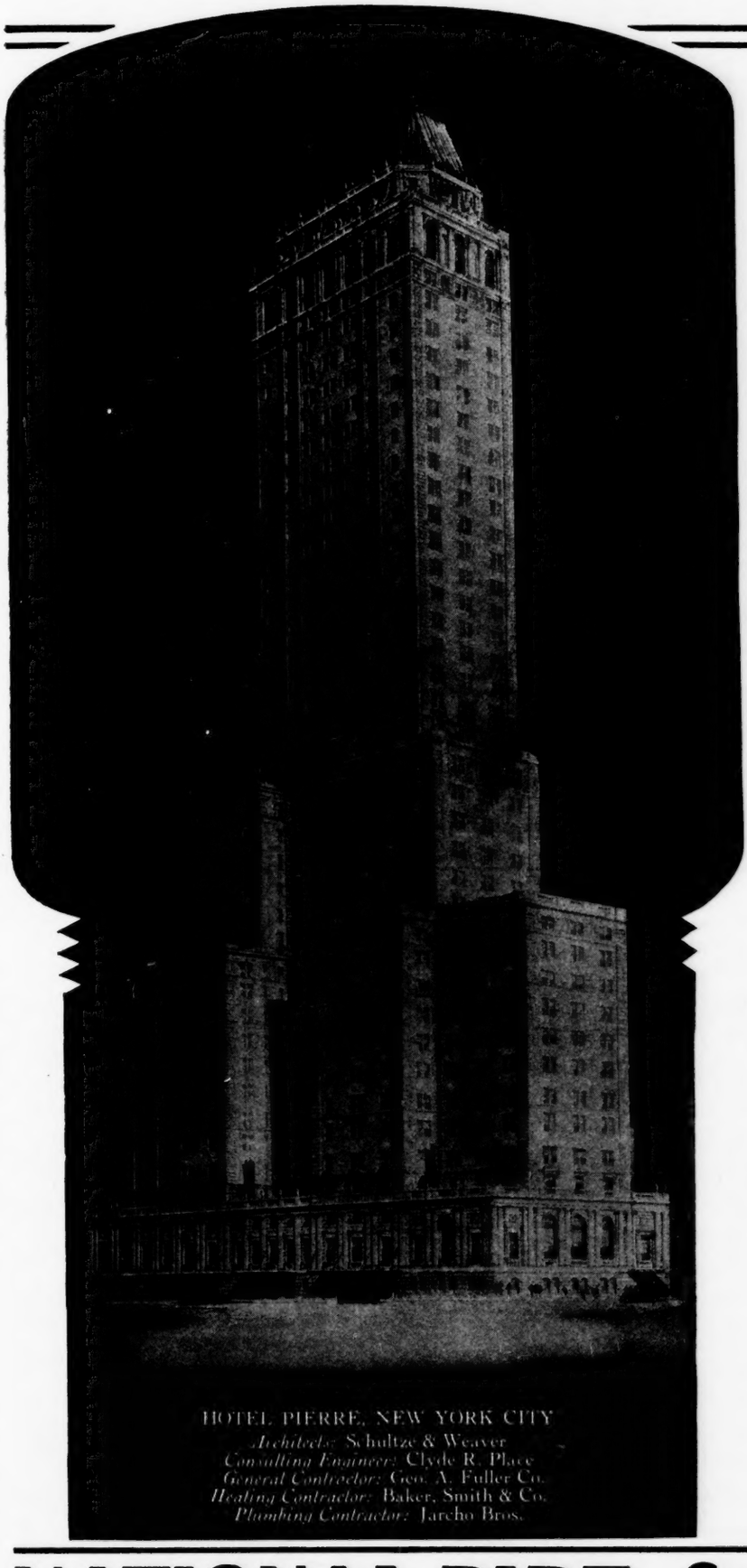
GAUGES, COMBINATION PRESSURE AND ALTITUDE
Bristol Co., Waterbury, Conn.
Marsh, Jas. P., Chicago, Ill.
Mercoid Corp., Chicago, Ill.

GAUGES, DRAFT
Bristol Co., The, Waterbury, Conn.
Marsh & Co., Jas. P., Chicago, Ill.

GAUGES, HYDRAULIC
Bristol Co., The, Waterbury, Conn.
Marsh & Co., Jas. P., Chicago, Ill.
Mercoid Corporation, Chicago, Ill.

GAUGES, PRESSURE
American Radiator Co., New York, N. Y.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Bristol Co., The, Waterbury, Conn.
Crane Co., Chicago, Ill.
Hoffman Specialty Co., New York.
Illinois Engineering Co., Chicago, Ill.
Marsh & Co., Jas. P., Chicago, Ill.
Mercoid Corporation, Chicago, Ill.
Pittsburgh Equitable Meter Co., Pittsburgh, Pa.
Sterling Engineering Co., Milwaukee, Wis.

GAUGES, VACUUM
American Radiator Co., New York, N. Y.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Bristol Co., Waterbury, Conn.
Crane Co., Chicago, Ill.
Hoffman Specialty Co., New York.
Illinois Engineering Co., Chicago, Ill.
Marsh & Co., Jas. P., Chicago, Ill.
Mercoid Corporation, Chicago, Ill.
Sterling Engineering Co., Milwaukee, Wis.
Webster & Co., Warren, Camden, N. J.



HOTEL PIERRE, NEW YORK CITY
Architects: Schultze & Weaver
Consulting Engineers: Clyde R. Place
General Contractors: Geo. A. Fuller Co.
Heating Contractor: Baker, Smith & Co.
Plumbing Contractor: Jarcho Bros.

ONE OF FIFTH AVENUE'S FINEST

AGAIN uptown New York comes to the front with the erection of the palatial new Hotel Pierre. This splendid hostelry with beautiful lines of Georgian architecture, rises forty stories above Fifth Avenue at Sixty-first Street.

The unique interior arrangement reveals how splendidly the architects and engineers have achieved spaciousness and distinction through modern design and construction. That extremely careful consideration was given to mechanical equipment, particularly the piping, is evidenced by the specification of NATIONAL for the major pipe tonnage. In addition to National Pipe for the heating lines, National Copper-Steel Pipe (especially resistant to atmospheric corrosion) was selected for the soil, waste, vent lines, rain leaders and fire lines.

Architects and engineers interested in the advantages of NATIONAL Pipe for heating and ventilating systems should write for Bulletin No. 19, describing NATIONAL —

America's Standard Wrought Pipe.

NATIONAL TUBE COMPANY
Subsidiary of United States Steel Corporation
PITTSBURGH, PA.

NATIONAL PIPE *for* HEATING

GAUGES, VACUUM (COMPOUND)
Bishop & Babcock Sales Co., Cleveland, Ohio.
Bristol Co., The, Waterbury, Conn.
Hoffman Specialty Co., New York.
Illinois Engineering Co., Chicago, Ill.
Marsh & Co., Jas. P., Chicago, Ill.
Mercoid Corporation, Chicago, Ill.
Sterling Engineering Co., Milwaukee, Wis.
Webster & Co., Warren, Camden, N. J.

GAUGES, VOLUME
Pittsburgh Equitable Meter Co., Pittsburgh, Pa.

GAUGES, WATER
Bristol Co., The, Waterbury, Conn.
Crane Co., Chicago, Ill.
Marsh & Co., Jas. P., Chicago, Ill.
Mercoid Corporation, Chicago, Ill.
The Stack Heater Co., Boston, Mass.

GENERATOR COOLING SYSTEMS
American Air Filter Co., Louisville, Ky.
Bayley Blower Co., Milwaukee, Wis.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Buffalo Forge Co., Buffalo, N. Y.
Schutte & Koerting Co., Philadelphia, Pa.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

GOVERNORS (PUMP)
Atlas Valve Co., Newark, N. J.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Crane Co., Chicago, Ill.
Kieley & Mueller, Inc., New York.
Marsh & Co., Jas. P., Chicago, Ill.
Watts Regulator Co., Lawrence, Mass.
Webster & Co., Warren, Camden, N. J.

GRATES, DUMPING
Coatesville Boiler Works, Coatesville, Pa.
Fitzgibbons Boiler Co., Inc., New York.
Kewanee Boiler Corp., Kewanee, Ill.
Stanwood Corp., Cincinnati, Ohio.

GRATES, ROCKING
Coatesville Boiler Works, Coatesville, Pa.
Kewanee Boiler Corp., Kewanee, Ill.
Stanwood Corp., Cincinnati, Ohio.

GRATES, SHAKING
Coatesville Boiler Works, Coatesville, Pa.
Fitzgibbons Boiler Co., Inc., New York.
Kewanee Boiler Corp., Kewanee, Ill.
Stanwood Corp., Cincinnati, Ohio.

GRATES, SHAKING AND DUMPING
Coatesville Boiler Works, Coatesville, Pa.
Frost Mfg. Co., Galesburg, Ill.
Kewanee Boiler Corp., Kewanee, Ill.
Stanwood Corp., Cincinnati, Ohio.

GRATES, SHAKING, CIRCULAR
Coatesville Boiler Works, Coatesville, Pa.
Fitzgibbons Boiler Co., Inc., New York.

GRATES, STATIONARY
Coatesville Boiler Works, Coatesville, Pa.
Fitzgibbons Boiler Co., Inc., New York.
Frost Mfg. Co., Galesburg, Ill.
Stanwood Corp., Cincinnati, Ohio.

GRILLES
Metalace Co., So. Boston, Mass.

HEAT CABINETS
(See Radiators, Cabinet and Concealed)

HEATERS, AIR, FAN SYSTEM
Aerofin Corp., Newark, N. J.
Bayley Blower Co., Milwaukee, Wis.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Buffalo Forge Co., Buffalo, N. Y.
New York Blower Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
U. S. Blower & Heater Corp., Minneapolis, Minn.
Wing Mfg. Co., L. J., New York.
Young Radiator Co., Racine, Wis.

HEATERS, DOMESTIC WATER
Alberger Heater Co., Buffalo, N. Y.
American Radiator Co., New York, N. Y.
Crane Co., Chicago, Ill.
Frank Heater & Engineering Co., O. E. Buffalo, N. Y.
Illinois Malleable Iron Co., Chicago, Ill.
Kewanee Boiler Corp., Kewanee, Ill.
McDermott Water Heaters, Inc., New York, N. Y.
Monitor Boiler Co., Philadelphia, Pa.
Patterson-Kelley Co., New York.
Ross Heater & Mfg. Co., Buffalo, N. Y.
H. B. Smith Co., Westfield, Mass.
The Stack Heater Co., Boston, Mass.
Weil-McLain Co., Chicago, Ill.
Whitlock Coil Pipe Co., Hartford, Conn.

HEATERS, FEED WATER, (CLOSED)
Alberger Heater Co., Buffalo, N. Y.
Frank Heater & Engineering Co., O. E. Buffalo, N. Y.
Frost Mfg. Co., Galesburg, Ill.
Illinois Malleable Iron Co., Chicago, Ill.
McDermott Water Heaters, Inc., New York, N. Y.
Patterson-Kelley Co., New York.
Ross Heater & Mfg. Co., Buffalo, N. Y.
Schutte & Koerting Co., Philadelphia, Pa.
Stanwood Corp., Cincinnati, Ohio.
The Stack Heater Co., Boston, Mass.
Watts Regulator Co., Lawrence, Mass.
Whitlock Coil Pipe Co., Hartford, Conn.

HEATERS, FEED WATER (OPEN)
Frost Mfg. Co., Galesburg, Ill.
Stanwood Corp., Cincinnati, Ohio.

HEATERS, FUEL-OIL
Alberger Heater Co., Buffalo, N. Y.
Frank Heater & Engineering Co., O. E., Buffalo, N. Y.
McDermott Water Heaters, Inc., New York, N. Y.
Patterson-Kelley Co., New York.
Ross Heater & Mfg. Co., Buffalo, N. Y.
Schutte & Koerting Co., Philadelphia, Pa.
The Stack Heater Co., Boston, Mass.
Whitlock Coil Pipe Co., Hartford, Conn.

HEATERS, UNIT
Bayley Blower Co., Milwaukee, Wis.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Buffalo Forge Co., Buffalo, N. Y.
McQuay Radiator Corp., Minneapolis, Minn.
Nelson Corp., Herman, The, Moline, Ill.
New York Blower Co., Chicago, Ill.
Peerless Unit Ventilation Co., Inc., Bridgeport, Conn.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
U. S. Blower & Heater Corp., Minneapolis, Minn.
Wing Mfg. Co., L. J., New York.
Wolverine Tube Co., Detroit, Mich.
Young Radiator Co., Racine, Wis.

HEATERS, UNIT, GAS FIRED
General Gas Light Co., Kalamazoo, Mich.

HEATERS, UNIT, TURBINE DRIVEN
Automatic Turbo Heater Co., Chicago, Ill.

HEATING SYSTEMS, GAS
Jas. B. Clow & Sons, Chicago, Ill.

HEATING SYSTEMS, VACUUM
Barnes & Jones, Boston, Mass.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Hoffman Specialty Co., New York.
Illinois Engineering Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Marsh & Co., Jas. P., Chicago, Ill.
Sarco Co., Inc., New York.
Sterling Engineering Co., Milwaukee, Wis.
Webster & Co., Warren, Camden, N. J.

HEATING SYSTEMS, VAPOR
Barnes & Jones, Boston, Mass.
Bishop & Babcock Sales Co., Cleveland, O.
Hoffman Specialty Co., New York.
Illinois Engineering Co., Chicago, Ill.
Marsh & Co., Jas. P., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Sarco Co., Inc., New York.
Simplex Heating Specialty Co., Inc., Lynchburg, Va.
Sterling Engineering Co., Milwaukee, Wis.
Vapor Engineering Co., New York.
Webster & Co., Warren, Camden, N. J.

HEATING SYSTEMS, WATER
American Radiator Co., New York, N. Y.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Grinnell Co., Providence, R. I.
Hornung, J. C., Chicago, Ill.
Ross Heater & Mfg. Co., Buffalo, N. Y.
The Stack Heater Co., Boston, Mass.

HUMIDIFIERS
American Air Filter Co., Louisville, Ky.
Bayley Blower Co., Milwaukee, Wis.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Buffalo Forge Co., Buffalo, N. Y.
Carrier Engineering Corp., Newark, N. J.
Grinnell Co., Providence, R. I.
Johnson Service Co., Milwaukee, Wis.
Lewis Corp., Minneapolis, Minn.
National Regulator Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
U. S. Blower & Heater Corp., Minneapolis, Minn.
Watts Regulator Co., Lawrence, Mass.

HUMIDITY CONTROL
American Air Filter Co., Louisville, Ky.
Bayley Blower Co., Milwaukee, Wis.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Carrier Engineering Corp., Newark, N. J.
Grinnell Co., Providence, R. I.
Johnson Service Co., Milwaukee, Wis.
Lewis Corp., Minneapolis, Minn.
National Regulator Co., Chicago, Ill.
Powers Regulator Co., Chicago, Ill.

INSTRUMENTS, ELECTRIC MEASURING
Bristol Co., The, Waterbury, Conn.

INSTRUMENTS, INDICATING AND RECORDING
Bristol Co., The, Waterbury, Conn.
Marsh & Co., Jas. P. Chicago, Ill.
Mercoid Corporation, Chicago, Ill.

INSULATION, BOILER, PIPE, ETC.
(See Covering, Boiler, Pipe, etc.)

INSULATION, BUILDING
Flax-li-num Insulating Co., St. Paul, Minn.
General Insulating & Mfg. Co., Alexandria, Ind.
Insulite Co., Minneapolis, Minn.
Johns-Manville Corp., New York, N. Y.

KETTLES, COPPER
Badger & Sons Co., E. B., Boston, Mass.

MECHANICAL DRAFT APPLIANCES
(See Draft Appliances, Mechanical)

METALS, THERMOSTATIC
Chace Valve Co., W. M., Detroit, Mich.

METERS, CONDENSATION
Central Station Steam Co., Detroit, Mich.

METERS, FEED WATER
Central Station Steam Co., Detroit, Mich.

METERS, PITOT TUBE
Buffalo Forge Co., Buffalo, N. Y.

METERS, WATER, GAS, OIL & AIR
Pittsburgh Equitable Meter Co., Pittsburgh, Pa.

MOTORS (ELECTRIC)
Baldor Electric Co., St. Louis, Mo.
Century Electric Co., St. Louis, Mo.
Emerson Electric Mfg. Co., St. Louis, Mo.
Janette Mfg. Co., Chicago, Ill.
Ohio Electric Mfg. Co., Cleveland, O.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

NOZZLES, SPRAY
Bayley Blower Co., Milwaukee, Wis.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Buffalo Forge Co., Buffalo, N. Y.
Carrier Engineering Corp., Newark, N. J.
Schutte & Koerting Co., Philadelphia, Pa.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

OIL BURNERS
Century Engineering Co., Cedar Rapids, Ia.
Electrol Inc., St. Louis, Mo.
Johnson Co., S. T., Oakland, Cal.
Petroleum Heat & Power Co., New York
Silent Automatic Corp., Detroit, Mich.

OIL BURNER EQUIPMENT
Buffalo Forge Co., Buffalo, N. Y.
Hornung, J. C., Chicago, Ill.
Janette Mfg. Co., Chicago, Ill.
Johnston Bros., Inc., Ferrysburg, Mich.
Schutte & Koerting Co., Philadelphia, Pa.

OIL BURNER IGNITION AND CONTROL EQUIPMENT
McAlear Mfg. Co., Chicago, Ill.
McDonnell & Miller, Chicago, Ill.
Mercoid Corporation, Chicago, Ill.
Penn Electric Switch Co., Des Moines, Iowa.
Penn Heat Control Co., Philadelphia, Pa.
Time-O-Stat Controls Co., Elkhart, Ind.
White Mfg. Co., St. Paul, Minn.

OZONE APPARATUS
United States Ozone Co. of America, Scottdale, Pa.

PIPE BENDING
Badger & Sons Co., E. B., Boston, Mass.
Crane Co., Chicago, Ill.
Grinnell Co., Providence, R. I.
Whitlock Coil Pipe Co., Hartford, Conn.

PIPE, CAST-IRON
American Radiator Co., New York.

PIPE HANGERS
Crane Co., Chicago, Ill.
Grinnell Co., Providence, R. I.

PIPE THREADING & CUTTING MACHINES
Crane Co., Chicago, Ill.

PIPE, STEEL
Crane Co., Chicago, Ill.
National Tube Co., Pittsburgh, Pa.

PRESSURE REDUCING VALVES
(See Regulators, Pressure).

PUMPS, CENTRIFUGAL
American Steam Pump Co., Battle Creek, Mich.
Nash Engineering Co., So. Norwalk, Ct.

PUMPS, CENTRIFUGAL, VACUUM HEATING
American Steam Pump Co., Battle Creek, Mich.
Ames Pump Co., New York.
Hoffman Specialty Co., New York.
Nash Engineering Co., So. Norwalk, Ct.
Skidmore Corp., St. Joseph, Mich.

PUMPS, CONDENSATION
American Steam Pump Co., Battle Creek, Mich.
Ames Pump Co., New York.
Decatur Pump Co., Decatur, Ill.
Hoffman Specialty Co., New York.
Nash Engineering Co., So. Norwalk, Ct.
Skidmore Corp., St. Joseph, Mich.
Sterling Engineering Co., Milwaukee, Wis.

PUMPS, OIL
Janette Mfg. Co., Chicago, Ill.

PUMPS, SUMP
American Steam Pump Co., Battle Creek, Mich.
Janette Mfg. Co., Chicago, Ill.
Nash Engineering Co., So. Norwalk, Ct.

PUMPS, TURBINE
Ames Pump Co., New York.
Decatur Pump Co., Decatur, Ill.
Nash Engineering Co., So. Norwalk, Ct.

PUMPS, VACUUM
American Steam Pump Co., Battle Creek, Mich.
Ames Pump Co., New York.
Janette Mfg. Co., Chicago, Ill.
Nash Engineering Co., So. Norwalk, Ct.
Skidmore Corp., St. Joseph, Mich.

RADIATION, LIGHT WEIGHT, NON FERROUS
American Radiator Co., New York.
McQuay Radiator Corp., Minneapolis, Minn.
The Herman Nelson Corp., Moline, Ill.
Young Radiator Co., Racine, Wis.

RADIATOR ENCLOSURES AND SHIELDS
McQuay Radiator Corp., Chicago, Ill.

RADIATOR HANGERS
American Radiator Co., New York, N. Y.
Grinnell Co., Providence, R. I.
Hartmann Co., Charles, Brooklyn, N. Y.
Healy-Ruff Co., St. Paul, Minn.
Kewanee Boiler Corp., Kewanee, Ill.
McAlear Mfg. Co., Chicago, Ill.

RADIATOR TUBES, COPPER
Wolverine Tube Co., Detroit, Mich.

RADIATORS, CABINET AND CONCEALED
Fintube Radiator Co., Long Island City, N. Y.
McQuay Radiator Corp., Minneapolis, Minn.
Nelson Corp., Herman, The, Moline, Ill.
Young Radiator Co., Racine, Wis.

RADIATORS, CAST-IRON
American Radiator Co., New York, N. Y.
Burnham Boiler Corp., Irvington, N. Y.
Crane Co., Chicago, Ill.
Kewanee Boiler Corp., Kewanee, Ill.
Nelson Corp., Herman, The, Moline, Ill.
H. B. Smith Co., Westfield, Mass.

RADIATORS, GAS-FIRED
American Radiator Co., New York, N. Y.
Jas. B. Clow & Sons, Chicago, Ill.

RADIATORS, VERTICAL FIN
Wolverine Tube Co., Detroit, Mich.

RECEIVERS, AIR
Brownell Co., The, Dayton, Ohio.
Frost Mfg. Co., Galesburg, Ill.
Vapor Engineering Co., New York.
Whitlock Coil Pipe Co., Hartford, Conn.

RECEIVERS, CONDENSATION
Crane Co., Chicago, Ill.
Illinois Engineering Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
The Stack Heater Co., Boston, Mass.
Vapor Engineering Co., New York.
Whitlock Coil Pipe Co., Hartford, Conn.

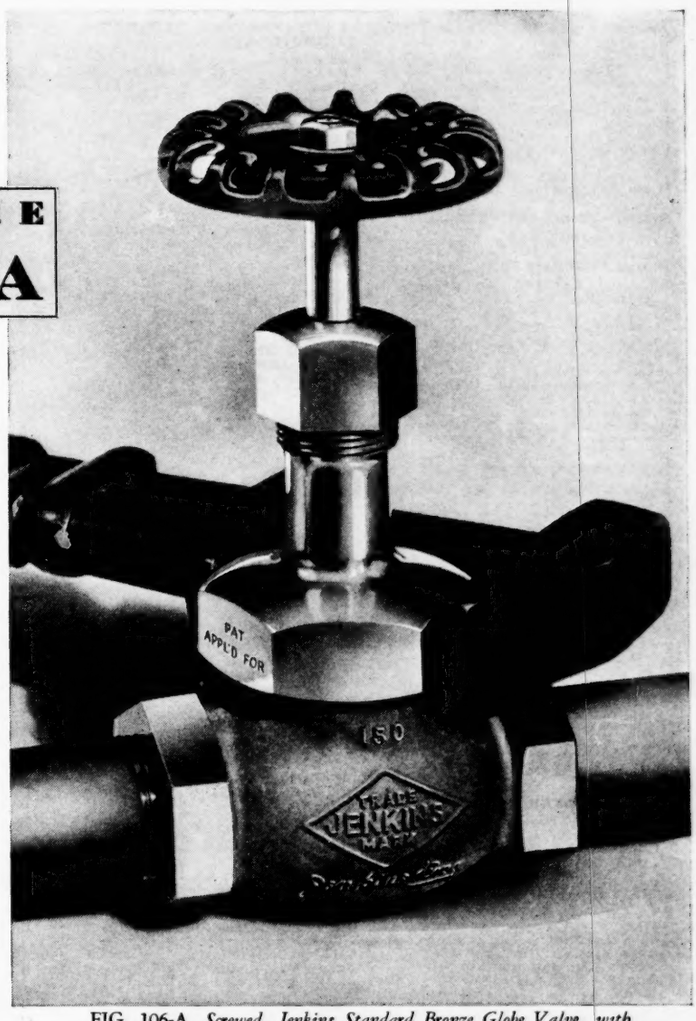
REGULATORS, BOILER-FEED
Atlas Valve Co., Newark, N. J.
Kieley & Mueller, Inc., New York.
McAlear Mfg. Co., Chicago, Ill.
McDonnell & Miller, Chicago, Ill.
The Stack Heater Co., Boston, Mass.
Watts Regulator Co., Lawrence, Mass.

REGULATORS, DAMPER
American Radiator Co., New York, N. Y.
Atlas Valve Co., Newark, N. J.
Barber-Colman Co., Rockford, Ill.
Hoffman Specialty Co., New York.
Illinois Engineering Co., Chicago, Ill.
Johnson Service Co., Milwaukee, Wis.
Kieley & Mueller, Inc., New York.
McAlear Mfg. Co., Chicago, Ill.
Marsh & Co., Jas. P., Chicago, Ill.
National Regulator Co., Chicago, Ill.
Powers Regulator Co., Chicago, Ill.
Sarco Co., Inc., New York.
Simplex Heating Specialty Co., Inc., Lynchburg, Va.
The Stack Heater Co., Boston, Mass.
Sterling Engineering Co., Milwaukee, Wis.
Watts Regulator Co., Lawrence, Mass.
White Mfg. Co., St. Paul, Minn.

REGULATORS, GAS
Pittsburgh Equitable Meter Co., Pittsburgh, Pa.

REGULATORS, PRESSURE
Atlas Valve Co., Newark, N. J.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Bristol Co., The, Waterbury, Conn.
Crane Co., Chicago, Ill.
Hornung, J. C., Chicago, Ill.
Illinois Engineering Co., Chicago, Ill.
Jenkins Bros., New York.

FIGURE
106-A



This one-piece screw-over bonnet won't distort . . .

FIG. 106-A, *Screwed, Jenkins Standard Bronze Globe Valve, with one-piece screw-over bonnet and slip-on stay-on disc holder. For 150 lbs. steam working pressure, or 250 lbs. oil, water, gas working pressure.*

Here is a valve that doesn't "fear" a wrench. It is a Fig. 106-A Jenkins Standard Bronze Globe with the one-piece screw-over bonnet.

This bonnet construction provides unusual strength to resist the strains of frequent removal. You can take the bonnet off and replace it repeatedly, and it won't distort. The large hex faces enable you to get a full purchase with a wrench.

Another advantage of Fig. 106-A is the slip-on stay-on disc holder . . . . a real innovation, possible only in this screw-over bonnet design. Ask your supply man to show you this Jenkins. Its superiority of construction and finish can be seen at a glance. It is made also in angle, cross and check types, screwed or flanged. Write for Bulletin 141 containing details.

JENKINS BROS.

80 White Street, New York, N. Y. 524 Atlantic Avenue, Boston, Mass. 133 No. Seventh Street, Philadelphia, Pa. 646 Wash. Blvd., Chicago, Ill. 1121 No. San Jacinto, Houston, Tex.
JENKINS BROS., Limited, Montreal, Canada; London, England
Factories: Bridgeport, Conn.; Elizabeth, N. J.; Montreal, Canada

Jenkins
VALVES
Since 1864

JENKINS VALVES ARE ALWAYS MARKED WITH THE "DIAMOND"

Johnson Service Co., Milwaukee, Wis.
Kainer & Company, Chicago, Ill.
Kieley & Mueller, Inc., New York.
Lytton Mfg. Corp., Franklin, Va.
McAlear Mfg. Co., Chicago, Ill.
Marsh & Co., Jas. P., Chicago, Ill.
National Regulator Co., Chicago, Ill.
Pittsburgh Equitable Meter Co., Pittsburgh, Pa.
Powers Regulator Co., Chicago, Ill.
Schutte & Koerting Co., Philadelphia, Pa.
The Stack Heater Co., Boston, Mass.
Watts Regulator Co., Lawrence, Mass.

REGULATORS, TEMPERATURE
(See Temperature Control)

REGULATOR, WATER
Pittsburgh Equitable Meter Co., Pittsburgh, Pa.

SEPARATORS, OIL
Bishop & Babcock Sales Co., Cleveland, Ohio.
Crane Co., Chicago, Ill.
Illinois Engineering Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Patterson-Kelley Co., New York.
Schutte & Koerting Co., Philadelphia, Pa.
Webster & Co., Warren, Camden, N. J.

SEPARATORS, STEAM
Bishop & Babcock Sales Co., Cleveland, Ohio.
Crane Co., Chicago, Ill.
Illinois Engineering Co., Chicago, Ill.
Webster & Co., Warren, Camden, N. J.

SPRAY COOLING SYSTEMS
Bayley Blower Co., Milwaukee, Wis.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Buffalo Forge Co., Buffalo, N. Y.
Schutte & Koerting Co., Philadelphia, Pa.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

SPRAY NOZZLES
(See Nozzles, Spray)

STERILIZER, WATER
U. S. Ozone Corp., Scottdale, Penn.

STOKERS, MECHANICAL
Brownell Co., Dayton, Ohio.
Detroit Stoker Co., Detroit, Mich.
Domestic Stoker Co., New York.
Whiting Corp., Harvey, Ill.

STRAINERS, OIL
Bishop & Babcock Sales Co., Cleveland, Ohio.
Illinois Engineering Co., Chicago, Ill.
Janette Mfg. Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Pittsburgh Equitable Meter Co., Pittsburgh, Pa.
Sarco Co., Inc., New York.
Schutte & Koerting Co., Philadelphia, Pa.

STRAINERS, STEAM
Bishop & Babcock Sales Co., Cleveland, Ohio.
Illinois Engineering Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Sarco Co., Inc., New York.
Schutte & Koerting Co., Philadelphia, Pa.

STRAINERS, WATER
Illinois Engineering Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Pittsburgh Equitable Meter Co., Pittsburgh, Pa.
Ross Heater & Mfg. Co., Buffalo, N. Y.
Sarco Co., Inc., New York.
Schutte & Koerting Co., Philadelphia, Pa.
Watts Regulator Co., Lawrence, Mass.

TANKS, COPPER
Badger & Sons Co., E. B., Boston, Mass.
McDermott Water Heaters, Inc., New York, N. Y.

TANKS, STEEL
McDermott Water Heaters, Inc., New York, N. Y.

TEMPERATURE CONTROL
American Radiator Co., New York, N. Y.
Atlas Valve Co., Newark, N. J.
Barber-Colman Co., Rockford, Ill.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Bristol Co., The, Waterbury, Conn.
Carrier Engineering Corp., Newark, N. J.
Fulton Sylphon Co., Knoxville, Tenn.
Hornung, J. C., Chicago, Ill.
Illinois Engineering Co., Chicago, Ill.
Johnson Service Co., Milwaukee, Wis.
Kieley & Mueller, Inc., New York.
Marsh & Co., Jas. P., Chicago, Ill.
Mercoid Corporation, Chicago, Ill.
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
National Regulator Co., Chicago, Ill.
Powers Regulator Co., Chicago, Ill.
Penn Electric Switch Co., Des Moines, Iowa.
Raymond, F. I., Chicago, Ill.
Sarco Co., Inc., New York.
The Stack Heater Co., Boston, Mass.
Stat-Amatic Instrument & Appliance Co., Hartford, Conn.
Sterling Engineering Co., Milwaukee, Wis.
Time-O-Stat Controls Co., Elkhart, Ind.
Watts Regulator Co., Lawrence, Mass.
White Mfg. Co., St. Paul, Minn.

THERMOMETERS, RECORDING AND INDICATING
American Radiator Co., New York, N. Y.
Bristol Co., The, Waterbury, Conn.
Marsh & Co., Jas. P., Chicago, Ill.
Powers Regulator Co., Chicago, Ill.
Standard Thermometer, Inc., Boston, Mass.

THERMOSTATIC METAL
W. M. Chace Valve Co., Detroit, Mich.

THERMOSTATS
Barber-Colman Co., Rockford, Ill.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Bristol Co., The, Waterbury, Conn.
Johnson Service Co., Milwaukee, Wis.
Marsh & Co., Jas. P., Chicago, Ill.
Mercoid Corporation, Chicago, Ill.
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
National Regulator Co., Chicago, Ill.
Powers Regulator Co., Chicago, Ill.
Sarco Co., Inc., New York.
Stat-Amatic Instrument & Appliance Co., Hartford, Conn.
Time-O-Stat Controls Co., Elkhart, Ind.
White Mfg. Co., St. Paul, Minn.

TRAPS, BUCKET
Crane Co., Chicago, Ill.
Marsh & Co., Jas. P., Chicago, Ill.

TRAPS, FLOAT
Crane Co., Chicago, Ill.
Marsh & Co., Jas. P., Chicago, Ill.
Sarco Co., Inc., New York.

TRAPS, FLOAT & THERMOSTATIC
Marsh & Co., Jas. P., Chicago, Ill.
Sarco Co., Inc., New York, N. Y.

TRAPS, INVERTED BUCKET (STEAM AND AIR)
Armstrong Machine Wks., Three Rivers, Mich.

TRAPS, LIFTING
Crane Co., Chicago, Ill.
Lytton Mfg. Corp., Franklin, Va.

TRAPS, RADIATOR
Armstrong Machine Wks., Three Rivers, Mich.
Barnes & Jones, Boston, Mass.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Crane Co., Chicago, Ill.
Hoffman Specialty Co., New York.
Illinois Engineering Co., Chicago, Ill.
Jenkins Bros., New York.
Johns-Manville Corp., New York, N. Y.
Marsh & Co., Jas. P., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Sarco Co., Inc., New York.
Sterling Engineering Co., Milwaukee, Wis.
Vapor Engineering Co., New York City.
Webster & Co., Warren, Camden, N. J.

TRAPS, RETURN
Bishop & Babcock Sales Co., Cleveland, Ohio.
Crane Co., Chicago, Ill.
Illinois Engineering Co., Chicago, Ill.
Johns-Manville Corp., New York, N. Y.
Kieley & Mueller, Inc., New York.
Lytton Mfg. Corp., Franklin, Va.
Marsh & Co., Jas. P., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Sarco Co., Inc., New York.
Simplex Heating Specialty Co., Inc., Lynchburg, Va.
Sterling Engineering Co., Milwaukee, Wis.
Webster & Co., Warren, Camden, N. J.

TRAPS, STEAM
Barnes & Jones, Boston, Mass.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Crane Co., Chicago, Ill.
Hoffman Specialty Co., New York.
Illinois Engineering Co., Chicago, Ill.
Johns-Manville Corp., New York, N. Y.
Kieley & Mueller, Inc., New York.
Lytton Mfg. Corp., Franklin, Va.
Marsh & Co., Jas. P., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Powers Regulator Co., Chicago, Ill.
Sarco Co., Inc., New York.

TRAPS, VACUUM
Barnes & Jones, Boston, Mass.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Crane Co., Chicago, Ill.
Hoffman Specialty Co., New York.
Illinois Engineering Co., Chicago, Ill.
Lytton Mfg. Corp., Franklin, Va.
Marsh & Co., Jas. P., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Sarco Co., Inc., New York.
Schutte & Koerting Co., Philadelphia, Pa.
Sterling Engineering Co., Milwaukee, Wis.
Webster & Co., Warren, Camden, N. J.

TUBING, COPPER AND BRASS
Crane Co., Chicago, Ill.

TUBING, SEAMLESS, COPPER, BRASS AND ALUMINUM
Wolverine Tube Co., Detroit, Mich.

TURBINES, STEAM
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Wing Mfg. Co., L. J., New York.

TURBO-BLOWERS
Bayley Blower Co., Milwaukee, Wis.
Buffalo Forge Co., Buffalo, N. Y.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Wing Mfg. Co., L. J., New York.

UNIT HEATERS
(See Heaters, Unit)

VACUUM CLEANING APPARATUS
American Radiator Co., New York, N. Y.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

VALVES, ACID RESISTING
Crane Co., Chicago, Ill.

VALVES, AIR, AUTOMATIC
American Radiator Co., New York, N. Y.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Crane Co., Chicago, Ill.
Fulton Sylphon Co., Knoxville, Tenn.
Hoffman Specialty Co., New York.
Jenkins Bros., New York.
Kelly Brass Works, Chicago, Ill.
Marsh & Co., Jas. P., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
National Regulator Co., Chicago, Ill.
Powers Regulator Co., Chicago, Ill.

VALVES, AIR RELIEF
American Radiator Co., New York, N. Y.
Barnes & Jones, Boston, Mass.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Crane Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Marsh & Co., Jas. P., Chicago, Ill.
Pittsburgh Equitable Meter Co., Pittsburgh, Pa.
Sarco Co., Inc., New York.
The Stack Heater Co., Boston, Mass.

VALVES, BACK PRESSURE
Crane Co., Chicago, Ill.
Illinois Engineering Co., Chicago, Ill.
Illinois Malleable Iron Co., Chicago, Ill.
Jenkins Bros., New York.
Kieley & Mueller, Inc., New York.
McAlear Mfg. Co., Chicago, Ill.
Pittsburgh Equitable Meter Co., Pittsburgh, Pa.
Schutte & Koerting Co., Philadelphia, Pa.

VALVES, BALANCED
Crane Co., Chicago, Ill.
Illinois Engineering Co., Chicago, Ill.
Jenkins Bros., New York.
Kieley & Mueller, Inc., New York.
McAlear Mfg. Co., Chicago, Ill.
Powers Regulator Co., Chicago, Ill.
Schutte & Koerting Co., Philadelphia, Pa.
Watts Regulator Co., Lawrence, Mass.

VALVES, BLOW-OFF
Crane Co., Chicago, Ill.
Jenkins Bros., New York.
Lytton Mfg. Corp., Franklin, Va.
Pittsburgh Equitable Meter Co., Pittsburgh, Pa.

VALVES, CHECK
Crane Co., Chicago, Ill.
Grinnell Co., Providence, R. I.
Illinois Malleable Iron Co., Chicago, Ill.
Jenkins Bros., New York.
Schutte & Koerting Co., Philadelphia, Pa.

VALVES, DIFFERENTIAL RELIEF, GAS
Pittsburgh Equitable Meter Co., Pittsburgh, Pa.

VALVES, FLOAT
Atlas Valve Co., Newark, N. J.
Crane Co., Chicago, Ill.
Grinnell Co., Providence, R. I.
Illinois Engineering Co., Chicago, Ill.
Kieley & Mueller, Inc., New York.
McAlear Mfg. Co., Chicago, Ill.
Marsh & Co., Jas. P., Chicago, Ill.
Schutte & Koerting Co., Philadelphia, Pa.
Time-O-Stat Controls Co., Elkhart, Ind.
Watts Regulator Co., Lawrence, Mass.

VALVES, GATE
Crane Co., Chicago, Ill.
Grinnell Co., Providence, R. I.
Illinois Malleable Iron Co., Chicago, Ill.
Jenkins Bros., New York.
Marsh Valve Co., Dunkirk, N. Y.

VALVES, GLOBE, ANGLE & CROSS
Crane Co., Chicago, Ill.
Grinnell Co., Providence, R. I.
Illinois Malleable Iron Co., Chicago, Ill.
Jenkins Bros., New York.
Marsh Valve Co., Dunkirk, N. Y.
Powers Regulator Co., Chicago, Ill.
Schutte & Koerting Co., Philadelphia, Pa.

VALVES, HYDRAULIC-OPERATING
Crane Co., Chicago, Ill.
Jenkins Bros., New York.
Kieley & Mueller, Inc., New York.

VALVES, MAGNETIC
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Time-O-Stat Controls Co., Elkhart, Ind.

VALVES, NON BY-PASS
The Stack Heater Co., Boston, Mass.

VALVES, NON-RETURN
Crane Co., Chicago, Ill.
Grinnell Co., Providence, R. I.
Illinois Engineering Co., Chicago, Ill.
Jenkins Bros., New York.
Kieley & Mueller, Inc., New York.
McAlear Mfg. Co., Chicago, Ill.

VALVES, RADIATOR
American Radiator Co., New York, N. Y.
Barber-Colman Co., Rockford, Ill.
Barnes & Jones, Boston, Mass.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Crane Co., Chicago, Ill.
Hoffman Specialty Co., New York.
Illinois Engineering Co., Chicago, Ill.
Jenkins Bros., New York.
Marsh & Co., Jas. P., Chicago, Ill.
Marsh Valve Co., Dunkirk, N. Y.
National Regulator Co., Chicago, Ill.
Powers Regulator Co., Chicago, Ill.
Sarco Co., Inc., New York.
Simplex Heating Specialty Co., Inc., Lynchburg, Va.
Sterling Engineering Co., Milwaukee, Wis.
Vapor Engineering Co., New York.
Webster & Co., Warren, Camden, N. J.

VALVES, PRESSURE REDUCING
(See Regulators, Pressure)

VALVES, REGULATING
Atlas Valve Co., Newark, N. J.
Barber-Colman Co., Rockford, Ill.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Bristol Co., The, Waterbury, Conn.
Crane Co., Chicago, Ill.
Fulton Sylphon Co., Knoxville, Tenn.
Hornung, J. C., Chicago, Ill.
Illinois Engineering Co., Chicago, Ill.
Jenkins Bros., New York.
Kainer & Co., Chicago, Ill.
Kieley & Mueller, Inc., New York.
McAlear Mfg. Co., Chicago, Ill.
Powers Regulator Co., Chicago, Ill.
Sarco Co., Inc., New York.

VALVES, RELIEF (WATER)
Crane Co., Chicago, Ill.
Kainer & Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Marsh & Co., Jas. P., Chicago, Ill.
The Stack Heater Co., Boston, Mass.

VALVES, SAFETY
American Radiator Co., New York, N. Y.
Crane Co., Chicago, Ill.
Jenkins Bros., New York.
Marsh & Co., Jas. P., Chicago, Ill.
Pittsburgh Equitable Meter Co., Pittsburgh, Pa.
The Stack Heater Co., Boston, Mass.
Time-O-Stat Controls Co., Elkhart, Ind.

VALVES, STOP AND CHECK
(See Valves, Non-Return)

VALVES, VACUUM RELIEF
The Stack Heater Co., Boston, Mass.
Watts Regulator Co., Lawrence, Mass.

VENTILATING SYSTEMS
American Radiator Co., New York, N. Y.
Bayley Blower Co., Milwaukee, Wis.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Buffalo Forge Co., Buffalo, N. Y.
Carrier Engineering Corp., Newark, N. J.
National Regulator Co., Chicago, Ill.
Nelson Corp., Herman, The, Moline, Ill.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
U. S. Blower & Heater Corp., Minneapolis, Minn.
Wing Mfg. Co., L. J., New York.

VENTILATORS
Bayley Blower Co., Milwaukee, Wis.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

VENTILATORS, FLOOR
Buffalo Forge Co., Buffalo, N. Y.
Knowles Mushroom Ventilator Co., New York.
Ventilating Products Co., Chicago, Ill.

VENTILATORS, UNIT
Nelson Corp., Herman, The, Moline, Ill.
Peerless Unit Ventilation Co., Inc., Bridgeport, Conn.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

ZONE HEATING SYSTEMS
Illinois Engineering Co., Chicago, Ill.
Marsh & Co., Jas. P., Chicago, Ill.

1855 · SEVENTY-FIFTH ANNIVERSARY · 1930

Only one point that might leak . . . and that repaired in a jiffy

Crane No. 112 Low Type Brass Radiator Valve

Thorough design in the Crane No. 112 Low Type Brass Radiator Valve has left only one place where leaks may sometimes develop . . . at the disc. The Crane renewable radiator valve disc, held firmly against the brass swivel disc holder by a brass washer and nut, with convenient wrench flats provided on the bonnet, can be reached and replaced in a trice.

The threaded bonnet is so constructed that there is no possibility of stripping or leakage. Frequent temperature changes are easily withstood. A liberal quantity of asbestos packing does away with frequent repacking of the stuffing box. In any steam or hot water radiator installation, such valves will reduce annoying troubles and complaints. They are examples of the quality that makes it pay architects, contractors, and builders to insist on Crane heating and plumbing materials. Write us for full information on this or any other item in the complete Crane line.

Valves CRANE *Fittings*

CRANE CO., GENERAL OFFICES: 836 S. MICHIGAN AVE., CHICAGO
NEW YORK OFFICES: 23 WEST 44TH STREET
Branches and Sales Offices in One Hundred and Ninety-six Cities

ALPHABETICAL INDEX OF ADVERTISEMENTS

A

Aerofin Corporation 24
Alberger Heater Co. 144
Alexander Bros. 139
American Radiator Co. 32, 56, 127, 132, 145
American Steam Pump Co. 25
Ames Pump Co. 121
Armstrong Cork & Insulation Co. . 159
Armstrong Machine Works. 48
Atlas Valve Co. 142
Automatic Turbo Heater Co. 140

B

Badger & Sons Co., E. B. 129
Baldor Electric Co. 150
Barber-Colman Co. 150
Barnes & Jones 138
Bayley Blower Co. 46
Bishop & Babcock Sales Co. 11
Brownell Co. 130
Bryan Steam Corp. 148
Buffalo Forge Co. 18
Burnham Boiler Corp. 138

C

Carrier Engineering Corp. 30, 31
Central Station Steam Co. 150
Century Electric Co. 42
Century Engineering Corp. 142
Chace Valve Co., W. M. 138
Clow & Sons, James B. 137
Coatesville Boiler Works. 14
Crane Co. 157

D

Decatur Pump Co. 146
Detroit Stoker Co. 23
Doherty-Brehm Co. 9
Domestic Stoker Co. 28

E

Electrol, Inc. 21
Emerson Electric Mfg. Co. 143

F

Fairbanks Co. 130
Fintube Radiator Co. 141
Fitzgibbons Boiler Co., Inc. 151
Flax-li-num Insulating Co. 123
Frank Heater & Engineering Co., Inc., O. E. 144
Frost Mfg. Co. 16
Fulton Sylphon Co. 134

G

G. & O. Mfg. Co. 130
General Gas Light Co. 141
Goetze Gasket & Packing Co., Inc. 140
Grinnell Co., Inc. 6, 7

H

Hartmann Co., Chas. 136
Healy-Ruff Co. 144
Heggie Simplex Boiler Co. 58
Hoffman Specialty Co., Inc. Back Cover
Hornung, J. C. 142

I

Illinois Engineering Co. 52
Illinois Malleable Iron Co. 133

J

Janette Mfg. Co. 146
Jenkins Bros. 155
Johns-Manville 12
Johnson Service Co. 43
Johnston Brothers, Inc. 135

K

Kainer & Company 130
Kelly Brass Works. 139
Kewanee Boiler Corp. 3
Kieley & Mueller, Inc. 142
Knowles Mushroom Ventilator Co. . 150

L

Lewis Corp. 34
Lytton Mfg. Co. 143

M

Marsh & Co., Jas. P. 160
Marsh Valve Co. 17
McAlear Mfg. Co. 150
McDermott Water Heater 151
McDonnell & Miller. 8
McQuay Radiator Corp. ..... 2nd Cover
Mercoid Corp., The 53
Metalace Corp., The 144
Minneapolis-Honeywell Regulator Co. 47
Monitor Boiler Co. 10

N

Nash Engineering Co. 36, 125
National Regulator Co. 5
National Tube Co. 153
Nelson Corp., Herman 19, 20
New York Blower Co. 146
Niagara Blower Co. 132
Nichols Products Corp. 13

O

Ohio Electric Mfg. Co. 146

P

Pacific Steel Boiler Corp. 140
Patterson-Kelley Co. 149
Peerless Unit Ventilation Co. 26
Penn Electric Switch Co. 29
Penn Heat Control Corp. 22
Petroleum Heat and Power Co. 54
Pittsburgh Equitable Meter Co. . . 137
Powers Regulator Co. 119

R

Raymond Co., F. I. 27
Ric-wiL Co. 147
Ross Heater & Mfg. Co. 148

S

Sarco Co., Inc. 60
Schutte Koerting Co. 150
Silent Automatic Corp. 35
Simplex Heating Specialty Co. 148
Skidmore Corp. 158
Skinner Bros. Mfg. Co., Inc. 51
Smith, H. B., Co. 37, 38, 39, 40
Spang, Chalfant & Co., Inc. 33
Stack Heater Co., The 151
Standard Thermometer, Inc. 148
Stanwood Corp., The 4
Stat-Amatic Instrument & Appliance Co. 146
Staynew Filter Corp. 147
Sterling Engineering Co. 140
Sturtevant Co., B. F. 44, 45

T

Thrush & Co., H. A. 57
Time-O-Stat Controls Co. 55

U

United States Blower and Heater Corp. 145
United States Ozone Company of America 148

V

Vapor Engineering Co. 144
Ventilating Products Co. 133

W

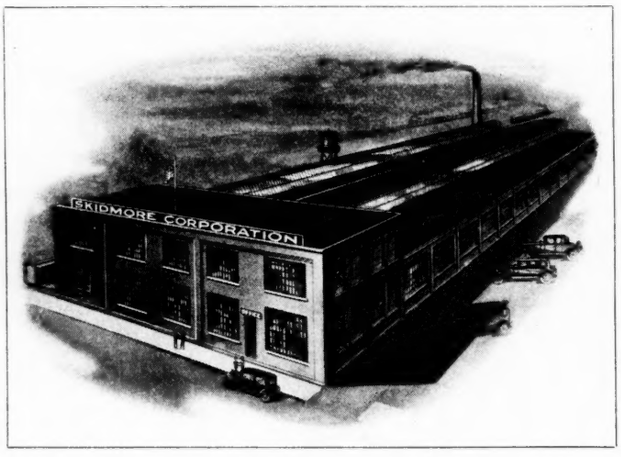
Want Advertisements 128
Watts Regulator Co. 151
Webster & Co., Warren 15, 41
Weil-McLain Co. ..... 3rd Cover
White Mfg. Co. 149
Whiting Corp. 49
Whitlock Coil Pipe Co. 135
Wing Mfg. Co., L. J. 50
Wolverine Tube Co. 142
Wood Engineering Co., Gar. 148

Y

Young Radiator Co. 136

SKIDMORE CORPORATION

IS NOW IN ITS NEW PLANT AND GENERAL OFFICES AT ST. JOSEPH, MICHIGAN



We are now doing business in our new plant and general offices at St. Joseph, Michigan.

SKIDMORE VACUUM PUMPS and SKIDMORE CONDENSATION PUMPS can now be had on short notice. Our new plant enables us to greatly speed up production and also give special attention to rush orders.

SKIDMORE CORPORATION

ST. JOSEPH, MICHIGAN

REPRESENTED IN ALL PRINCIPAL CITIES

MADE AND SOLD IN CANADA BY DARLING BROS., LTD., MONTREAL

AN UNSEEN HAND

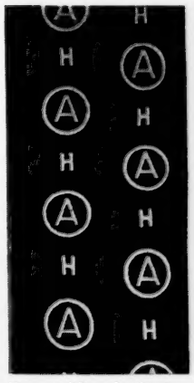
IS SHAKING YOUR MACHINERY

unless you've checked vibration with CORK

YOU can't see vibration, usually. But it is constantly at its destructive work—shaking your moving machines, jarring them, shortening their lives. That is, unless the vibration is checked by cork!

With Armstrong's Cork Machinery Isolation, the jarring and disagreeable "humming" are absorbed. Vibration becomes powerless. The machine is protected. So are other machines nearby, especially gauges and precision instruments. The entire building structure is safeguarded. The efficiency and comfort of employees is greatly increased, too.

This protection can be given to almost all moving machines. Their speed, action, and weight make no difference. Armstrong's Cork Machinery Isolation is made in three densities and seven thicknesses. It is only necessary, therefore, to determine what specification best suits the machine you want to safeguard.



To avoid substitutes, watch for the Circle A. The special cork boards are also marked for density; "H" stands for "heavy," one of the three densities available.

The cork-cushioning advantages can be secured at very moderate cost. Only a few dollars for even the largest, heaviest machinery. And the initial cost is all. Cork does not deteriorate or disintegrate. Even under steady compression it takes no "set," so its resiliency lasts as long as the machine lives.

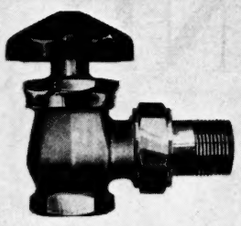
For the very best results, we suggest that you consult with our engineers. They will gladly give you estimates without obligation on your part. They can tell you, too, what type of Armstrong's Cork Machinery Isolation will be adequate for ordinary or special conditions. Just write to the Armstrong Cork & Insulation Company, 925 Concord Street, Lancaster, Pennsylvania.

Armstrong's (A) *Product*

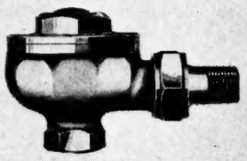
Armstrong's Cork Machinery Isolation

This List Will Help You

Armstrong's Cork Machinery Isolation is used for: air compressors, blowers, drill presses, drop hammers, elevator hoists, engines, fans, forging machines, machine tools, motors, motor generators, printing presses, pumps, punching machines, refrigerating machines, vacuum cleaners, and similar apparatus.

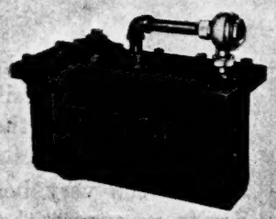


Marsh System Unit Radiator Valve



Marsh System Unit Radiator Trap

Marsh Air and Vacuum Valve



Marsh System Unit No. 9
Heavy Duty Trap

MARSH

presents

truly modern heating

at the

POWER SHOW

Booths No. 258-259 Dec. 1st to 6th

The products shown on this page illustrate a small part of the complete Marsh Line... but they cannot illustrate the enduring quality, the painstaking workmanship and the progressive engineering that are so vital a part of every Marsh System Unit and Marsh Heating System.

Come to Booths 258-259 at the Power Show and learn more about these products that are revolutionizing modern heating practice. Let our representative demonstrate the operating model of a Marsh Weather Compensating System of heating. He can give you conclusive evidence of the marked increase in economy and efficiency that results from the application of Marsh System Units.

JAS. P. MARSH & CO.

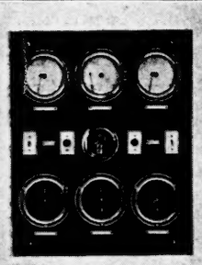
(Division of Commercial Instrument Corporation)

HOME OFFICE:

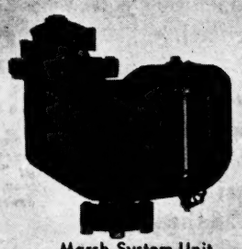
2075 Southport Ave., CHICAGO, ILL.

551 Fifth Ave., New York City — 2539 Pennsylvania Ave., N. W.

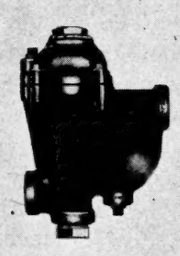
Bendix Bldg., Los Angeles, Calif. — Sales Offices in principal cities — Washington, D. C.



Marsh Type W Control Panel



Marsh System Unit
Equalizer and Return Trap



Marsh System Unit No. 8
Drip Trap

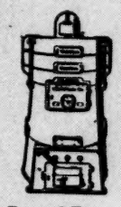
Marsh System Unit No. 12
Drip Trap

Marsh System Units T.M. REG.

Marsh Heating Systems T.M. REG.

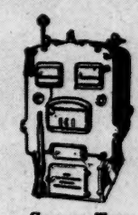
Marsh Industrial Instruments T.M. REG.

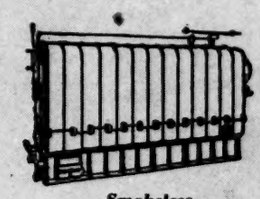
Weil-McLain Boilers fight fuel waste *and deliver more heat*


Round Type Boiler

Jacketed Boiler

Self-feed Boiler


Square Type Boiler


Smokeless Boiler

Cameo Radiator

Your Weil-McLain Distributor has a complete line of these Boilers and Radiators in all popular styles

Weil-McLain Scientific Combustion Boilers are carefully designed to take advantage of every possible factor that can contribute to fuel economy and utilization of heat. Outstanding structural advantages enable Weil-McLain Boilers to provide more heat and to save fuel. Home owners are quick to understand and appreciate these features.

30% to 40% more heat-absorbing surface

In Weil-McLain Round Boilers, for example, the crown sheet section and all other vital heat-absorbing surfaces are corrugated like this ~~~, instead of flat like this _____. These fuel-saving corrugations crowd perhaps a third more heat-absorbing surface into the same space. Equivalent heating surface is provided in all other types of Weil-McLain Boilers.

Balanced back-and-forth fire travel

More heat is actually utilized in Weil-McLain Boilers because Weil-McLain fire travel is not only back and forth but it is balanced. Variations in the rate at which boilers operate due to varying heat demands do not alter the long, balanced back-and-forth flow of gases through the flues.

There are Weil-McLain Boilers to meet all conditions — Round Type, Jacketed, Square, Self-feed and Smokeless. Also Weil-McLain "Cameo" Radiators.

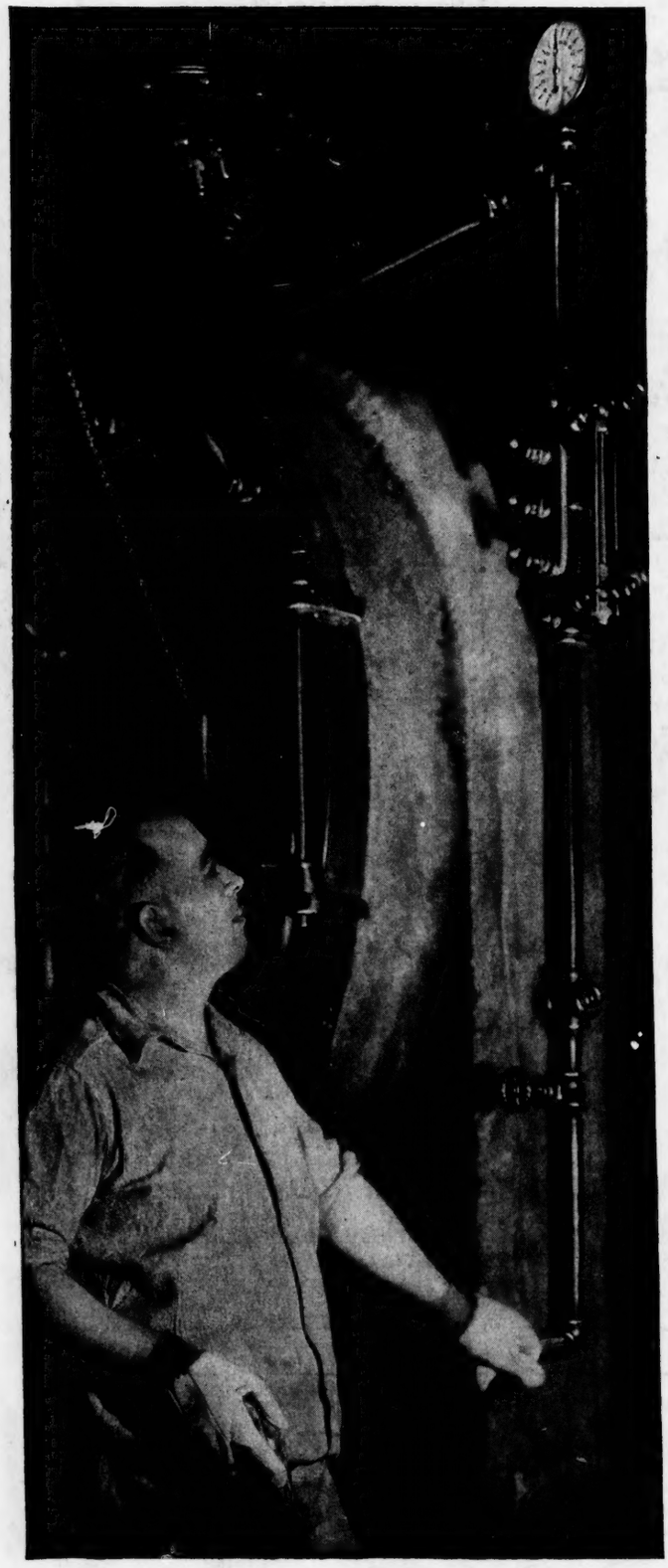
WEIL-McLAIN COMPANY, General Office, Chicago, Ill.
Boiler Plant and Offices: Michigan City, Ind.
Radiator Plant and Offices: Erie, Pa.

Jobbing distributors with local stocks in most jobbing centers

Weil-McLain
SCIENTIFIC COMBUSTION
BOILERS
fight fuel waste and deliver more heat

© 1930, W-McL.

The MAN WHO MAKES THE STEAM *tells of* HOFFMAN *Controlled Heat*



It isn't usual for the man at the business end of the coal scoop to get enthusiastic about any heating system. But when he *does* give praise you know his opinions are based, not on theory, but on actual, hard experience.

Take Victor Lammlin here, for example. He runs the steam plant at the beautiful Elizabeth Arden Apartments, located on Chicago's "Gold Coast." He says: "This Hoffman System takes the least work and is easier on the coal pile than any I've ever run into. Even in sub-zero weather, 8 ounces of steam is plenty. And I can bank my fires when the other fellow is working up steam pressure to keep things warm 'til midnight.

"What's more, the building manager isn't continually passing along tenant complaints to me. Hoffman Controlled Heat keeps everyone comfortable and happy."

This comes from a man who knows heating systems. For 15 years he's stoked the boilers of hotels, apartments and office buildings—he has contended with many heating problems.

There is a two-fold advantage in using Hoffman Controlled Heat. Low pressure steam, working in a vacuumized system, saves as much as ⅓ in fuel consumption. And room-by-room heat control—at the touch of a finger—brings temperature comfort suited to the individual.

In sky-scraper or bungalow—with coal, oil or gas fired boilers—Hoffman Controlled Heat gives a new conception of heating comfort and economy. Our representative will be glad to give you further information—or write for booklet. Hoffman Specialty Co., Inc., Dept. C-70, Waterbury, Conn.

This Hoffman Adjustable Modulating Valve insures uniform circulation to all radiators and by merely moving the little handle, desired individual room temperatures are assured.

HOFFMAN CONTROLLED HEAT